THE LONGITUDINAL HEALTH SURVEY:

I. Description

by

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NAVAL SUBMARINE MEDICAL RESEARCH LABORATORY REPORT No. 733

Bureau of Medicine and Surgery, Navy Department
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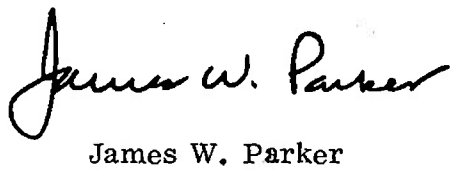

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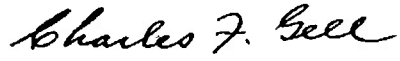

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SUMMARY PAGE

THE PROBLEM

To establish a continuing multiphasic medical survey of submarine and diving personnel, in order to ascertain possible long-range changes in the health and psychological makeup of the individual submariner or diver.

FINDINGS

Computer programs have been developed to facilitate assembling, storing and retrieving medical data. Data analysis is in process.

APPLICATION

Knowledge of physiologic and/or psychologic changes relative to long-term submarine or diving exposure will facilitate the correction of the precipitating factors or the control of the related biological mechanisms. This knowledge will also be a factor in protecting the Government against false claims relative to damage to personnel arising from such exposure.

ADMINISTRATIVE INFORMATION

This investigation was conducted as part of Bureau of Medicine and Surgery Research Work Unit MF51.524.006-1002BF9I. The present report is No. 1 on this work unit. It was received for review on 8 December 1972, approved for publication on 14 December 1972 and designated as NavSubMedRschLab Report No. 733.

PUBLISHED BY THE NAVAL SUBMARINE MEDICAL RESEARCH LABORATORY

ABSTRACT

A multiphasic medical screening program has been developed for randomly selected submarine and diving personnel. Each individual passes through twelve phases of data collection: a statement of personal background and history, psychological testing, selected anthropometry, roentgenography, dental evaluation, pulmonary ventilation tests, audiometry, electrocardiography, vision tests, selected blood chemistry analyses and physical examination. The accumulated data is coded on Holerith cards for ease of storage, retrieval and ultimate computer analysis. The present report defines the scope and objective of each of the measured parameters as well as the computer programs developed for the processing of these parameters.

It is intended that data shall be collected for 2,000 individuals and that follow-up data will be obtained at periodic intervals.

PREFACE AND ACKNOWLEDGMENTS

The concept of a Longitudinal Health Study for submarine and diving personnel was introduced into the planning of NSMRL by the Scientific Director, Dr. Charles F. Gell, in 1966. The reasoning for this program was based on several factors which were:

a. Several branches within the Laboratory, specifically Auditory, Vision, Pulmonary Physiology and Biochemistry expressed the need for a longitudinal health study within the scope of their discipline as a research requirement. It was reasoned that an evaluation of the whole man would be of more value than a piecemeal approach and also would provide for the specific disciplinary data requirement.

b. The apparent success of the 1,000 Aviator Study at the Naval Aerospace Medical Institute, at Pensacola, Florida from 1942 to the present, in which the Scientific Director of NSMRL had a continuing ancillary association and interest, indicated the feasibility and desirability of a LHS for submarine and diving personnel.

c. The recommendation by letter of the National Research Council Committee on Naval Medical Research to the Surgeon General, USN, that longitudinal health studies of a nature similar to that conducted at Pensacola should also be carried out in the underwater and surface Navy.

d. Specific suggestions by senior submarine flag officers for some program to identify the deleterious effects of submarine environment on involved personnel. These queries were made to the Surgeon General of the Navy in response to several premature deaths from cardiovascular accidents of former flag officers in the submarine Navy.

In 1967, with the establishment of the protocol and the support of CAPT Joseph Pollard, MC, USN, Code 7, BUMED, this study was approved and funded. However, the Longitudinal Health Study for submarine and diving personnel moved slowly in 1967 and 1968 because of the lack of uniformed medical personnel in the Laboratory.

In 1967 the project was headed by CDR Thomas N. Markham, MC, USN assisted by LCDR Donald W. Klopp, MC, USN. The protocol was organized and supported by visits to Pensacola and centers of civilian aging studies.

In 1968, CDR J. D. Bloom, MC, USN reported as the Military Director of the NSMRL. This provided great stimulus to the conduct of the LHS project, inasmuch as Dr. Bloom had had considerable interest in this type of study — having written his submarine medical officer thesis in this subject area.

In 1969, the project was headed by CDR Robert N. Sawyer, MC, USN as the principal investigator. CDR Sawyer concerned himself with the aspect of data acquisition and retrieval for the Longitudinal Health Study. The text of this report largely involves an exposition of his efforts. This is the first report of the LHS emanating from the NSMRL, and demonstrates on ongoing project encompassing contributions of many people.

The LHS is receiving the enthusiastic support of the present Officer in Charge, CAPT John H. Baker, MC, USN. The fact that approximately 300 subjects have been examined to date assures the continuity and success of the study.

Acknowledgments in addition to those previously mentioned are extended to the contributors to the study who are listed below:

CDR William R. Shiller, DC, USN	Dental Research Branch
CAPT M. A. Mazzarella, DC, USN	Head, Dental Research Branch
Dr. J. Donald Harris	Head, Auditory Branch
Dr. J. A. S. Kinney	Head, Vision Branch
Dr. B. B. Weybrew	Head, Personnel Research Branch
Dr. George Moeller	Head, Human Factors Branch
Dr. K. E. Schaefer	Head, Physiology Branch

In the process of discussion with interested physicians relative to the LHS, it became apparent that an attempt to review and

collect data from submarine personnel past as well as present, would be of some value. Dr. Ruport Hester is at present making a comprehensive review of past medical history of submarine and diving personnel with the assistance of responsible individuals from the Bureau of Medicine and Surgery and the National Research Council. Statistical information that will be derived from this background study will be published as an adjunct to the Longitudinal Health Study of submarine and diving personnel.

THE LONGITUDINAL HEALTH SURVEY:

I. Description

BACKGROUND:

The effect on submarine and diving personnel of exposure to their occupational environments has not been clearly defined, either for short or long exposures. Even definition of the results of such an occupational exposure is difficult. For the most part, pertinent data is essentially inaccessible, since it is scattered throughout several organizations and Bureaus, and is mostly contained on hand-written records. One difficulty is the constant turnover of the population, with major shifts of assignment and location within the Submarine Force, as well as movement of personnel to civilian life. Also, there are biological changes, both anticipated and unexpected, occurring over a period of years of occupational exposure. Finally, there has been no single medical group responsible for consideration, development and operation of a surveillance system necessary for such a purpose.

Precedent for this type of research group was established with the initiation of the Thousand Aviator Study, an investigation of a somewhat similar military group. This study has been a long-term investigation, extending over 30 years, and focusing in particular upon cardiovascular changes in an officer aviator population. In 1956 a monograph on this study was published by the Naval Aerospace Medical Institute (NAMI), covering 25 years of continuing periodic medical examination based upon an increasingly broad spectrum of biologic variables.[1] This publication documented the success of this long term multiphasic medical evaluation of a relatively large number of individuals. The experience of the NAMI group outlined in this paper should establish the feasibility of a study, expanded in scope of both variables and population, within the submarine and diving populations.[2] In December of 1967 a research protocol was submitted to finding the objectives and methodology of such an extended multiphasic examination system by the Submarine Medical Research Laboratory of the Naval Submarine Medical Center in Groton.[3] This was designated the Longitudinal Health Survey (LHS).

THE LONGITUDINAL HEALTH SURVEY

The Longitudinal Health Survey, now an active study of the Naval Submarine Medical Research Laboratory, is a continuous multiphasic medical examination survey of officers and enlisted men serving in submarine and diving activities. The ultimate purpose of the study is to define the medical status of this population, describe changes in their medical status, and thus ultimately improve health, safety and well-being of the submarine and diving population. In the early stages, the major effort of the LHS was toward development of a detailed medical questionnaire to be answered by the subject himself. Also, a nearly routine physical examination, including chest roentgenograms (CR) and an electrocardiogram (ECG) were obtained. Other procedures such as

tests of vision and pulmonary function were subsequently added, and the LHS examination system eventually assumed the characteristics of a true multiphasic system.[4]

SCOPE OF REPORT

This report will define the LHS medical evaluation concept and methodology as it stands on the date of this report and will describe additions and changes recommended.

Multiphasic studies require rapid and economical handling of data, with storage, retrieval, and analysis of numerous variables within a very large population. This requirement is greatly enhanced by the use of computers.[5,6] This report will define the use of processing with computers, and will define the coding, storage, retrieval and analysis techniques in the medical data system of the LHS. Longitudinal Health Survey data analysis will be covered in separate, subsequent reports.

STUDY ORGANIZATION

There are twelve phases through which an individual passes in the completion of the entire LHS program. These phases are determined by factors of efficiency for the examiners in performing various aspects of the examination.[7]

DATA ORGANIZATION AND PROCESSING

The basic organizational units of the LHS system are the corresponding specialized phases of the examination. The data system handles information in each phase from acquisition through storage, retrieval, and analysis. These data phases or study sections are assigned numbers. These numbers, called Index Numbers, appear on each data sheet and Holerith data cards, and specifically identify the corresponding examination phase.

The size of each Index is limited by the sorting unit size of the storage form, presently the card, and is thus 80 digits in length. Each phase of the LHS has at least one Index number, and may have more as is required by the amount of data. For example, the anthropometry phase has one index while the vision phase has two. Table I lists the Index Numbers for the twelve phases of the LHS.

Just as each data Index has a corresponding data card, each single item of data has a unique position or "address" within that card. As is noted in Table I, some testing functions, such as auditory testing and the physical examination, utilize a number of sequential data cards.

The data acquired in each phase is written on a corresponding printed data sheet within a convenient format appropriate to the test system of that phase. It is from these data sheets that a key punch operator translates the data to Holerith cards for storage and subsequent analysis.

In Figure 1, three steps are shown in the organization of data handling: first, the data acquisition from the subject; second, the transfer or recording of this data to a specific data sheet;

Table I: LHS Organization: Data Acquisition Phases and Index Numbers

Phase/Section	Index Number
Background	001
Psychological/Social	011
Mortality	013
Anthropometric	015
Roentgenography	020
Dental	021
Pulmonary Function	025
Auditory	031 - 034
Physical Examination, Narrative	051 - 070
Vision	071 - 072
Chemistry	081 - 082
Medical Histories	091 - 100

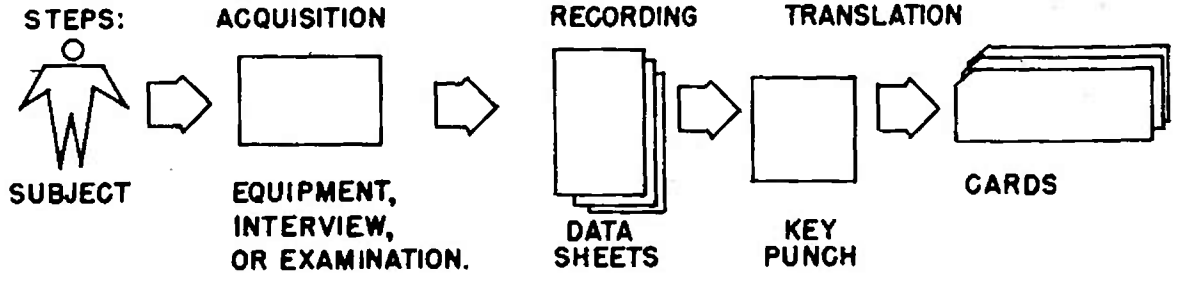


FIGURE 1.

finally, the translation of this data from this sheet to a form compatible with the electronic processing, in this case a Holerith card. Functionally, this final computer-compatible storage phase could be tape or disc, or include transfer between any modes such as cards, tapes or disc. Further, a direct input terminal system would accommodate direct entry of data from acquisition to storage form. These methods are all possibilities in future development of the LHS.[8]

Each data sheet and card not only has an Index number but is also identified as to person, place and time. This provides maximum "sortability" for retrieval and analysis and precludes loss of data through mixing or shifting of cards. Table II lists the identification items present on all cards, irrespective of Index or LHS phase.

This identification section utilizes the first 30 columns of each card. The remainder of the card is open for data and data processing information. The individual subject's name appears as data in two Index sections of the LHS: background and roentgenography.

The LHS data system possesses the important attribute of flexibility. The system can be shortened, lengthened or entered and expanded at any point. New techniques or history can be added at any time or any place within the entire system. Once the variables enter the data system, they are able to be manipulated in any fashion, and rearranged in any form. Further, any variable can be compared with any other within the entire system.

CODING There are a number of coding systems utilized in the

Table II: Identification Section of All Cards

Identification	Method
Testing Phase, Data Group	Index Number
Person	Social Security Number, Date of Birth: Day, Month, Year
Place	Facility Code Per BUMED INST. 6310.8.
Time	Date of Test or Examination

multiphasic examination systems that have been reviewed. In keeping with U.S. Navy convention, the diseases, surgical procedures and injuries in all phases of the LHS are coded by the "International Classification of Diseases as Adapted by the U.S. Center for Health Statistics," eighth edition. This is a two volume text, published by the World Health Organization, and commonly referred to as the ICDA-8.[9]

Demographic information has been coded using personnel, pay grade and geographic coding systems found in BUMED Instruction 6310.8.

All other coding systems and data recording conventions have been designed to minimize writing (and thus errors), reduce work, and facilitate translation. These ends are met in various ways appropriate to the specific LHS examination phase, and are described with each Index in this report.

COMPUTER FUNCTIONS

There are three general areas for computer function in the LHS: analysis of data; print-out of data; and editing.

Computer analysis of the variables in the anticipated large population to be studied requires the use of various functions of a statistical software computer system. These include histogram tracing, contingency table production, and computation of means, standard deviations, percentiles, and other statistical functions. Table III lists examples of such programs available at most university computer centers. The examples cited are for the Yale Computer where initial analysis of LHS data has been performed.[11] Language utilized was FORTRAN IV, and equipment IBM 7090 - 7094 in DCS configuration.

Table III: Partial List of Programs Available at Yale Computer Center

YCC No.	Program Title
38	Multiple Variate Frequency Tables.
50	T. Test with Optional Bartlett's Test.
55	Chi-Square with Correction for Low Frequency.
66	Table Programs.
73	Computation of Mean Scores, Standard Deviations and Standard Scores.
75	Correlation with Missing Data.
81	Missing Data Program for Computation of Mean Scores and Standard Deviations with Options for Correlation Coefficients, Standard Scores and Histograms.
92	Biomedical Programs.
101	Data-Text Regression Program

The second area of computer function is the rather simple action of printing out interpreted and readable information from the coded and packed data punched in the data cards. This may mean straight forward interpretation of punched information and printing in readable lists of columns or it may entail decoding a punched card with printing of appropriate descriptive words or phrases, such as physical findings or demographic information.

The third area of computer utilization is screening of data entered on cards for errors. The LHS is designed to accommodate a large volume of study subjects that conceivably may extend into the thousands. Also, the number of variables recorded for each individual is quite large. With the collection of a large number of data points, and such a broad spectrum of variables, it rapidly becomes humanly impossible to review the data and notice points which fall significantly distant from expected normal values. The situation is worsened by the use of automatic data processing systems. Machines will proceed to produce an analysis using whatever data is submitted, good or bad, precise or ridiculous .[12] Unfortunately, once data is given to this high speed system, the "garbage-in/gospel-out" phenomenon occurs.

It is with this in mind that significant effort has been devoted to the concept of minimizing the error content of the data. This led to the development of an objective examining system for rapid scanning of all data with subsequent indication of deviation from expected values. These data values in the LHS recording system are of two general classes. The first is a discrete variable representing, for instance, a given diagnosis, years of age, or packs of cigarettes smoked. The second class of entries are continuous variables such as height or weight. Limits or a range of possibilities can be established for these groups. Any variable whose value lies outside of these limits, or "window", is labeled an error within the context of the LHS data system. These abnormal values occur for a number of reasons. Table IV lists the various errors, usual sources, and corrective or indicated action.

The acquisition recording, or translation errors can be extreme in their magnitude and will cause error in the analysis of the population data. Biological-source abnormal data requires investigation and judgment. Appropriate review, remeasurement, and medical knowledge should be applied to the individual in question, most effectively while he is still locally available. Rapid review and analysis of data is thus necessary to this end.

These concepts resulted in the development of the PRINT-OUT/ OBJECTIVE PERUSAL SYSTEMS (POOPS). As is indicated, this is actually two separate programs: one a printout and another an edit, blended together for more efficiency. In this system each single item of data is read and objectively edited. It is then printed out with appropriate flagging or comment if not satisfactory or reasonable. There is a separate POOPS examination program for each

Table IV: LHS Data Errors: Sources and Indicated Action

Data Error	Error Source	Indicated Action
Acquisition Error	Equipment Malfunction. Machine Error. Faulty Technique.	Repair, replace or retrain. Correct data by repeating test.
Recording Error	Incorrect human recording of data acquisition.	Maintain vigilance and attitude in staff. Correct data.
Translation Error	Human error in keypunch. Machine error.	Verification keypunch techniques. Possible data sheet revision. Correct error.
Biologic Errors	Values normal for individual but exceed expected population values. "Tails" of the curve of normal biological distribution.	Evaluate, possibly repeat examination. Retain data.
	Abnormal with medical and pathological significance to the individual.	Appropriate follow-up for individual. Retain data.

of the phases of the LHS. Appropriate values have been determined for each single data item. An illustration of the function of the system is shown in Table V which lists the various limits or "windows" imposed on the items, coded and punched on LHS Index data cards. Note that the first 30 columns comprise the identification section described in Table II.

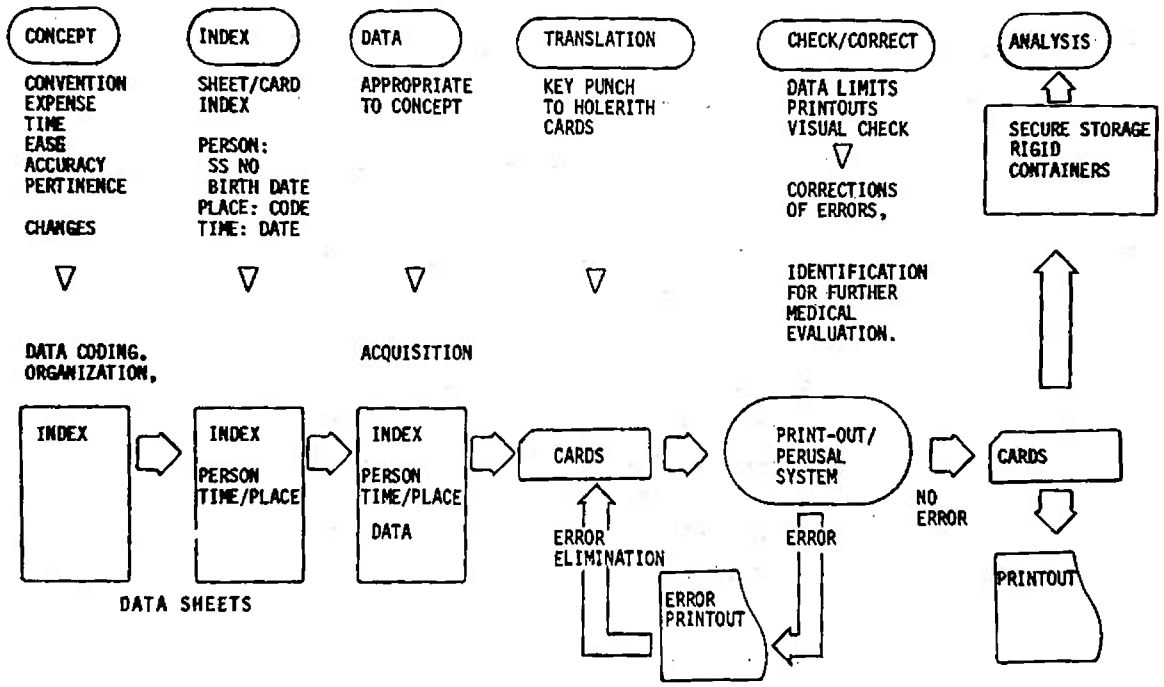
Thus the purposes of the POOPS system are to protect the study from analysis of erroneous data with subsequent distortion of the results and to protect the individual, if aberrant data represents pathology.

The entire LHS data system is summarized and schematically described in Figure 2, showing the

Table V: Edit Function of Print-Out/Objective Perusal System

Columns	Item	Variable Limits
1 - 3	Index	Only appropriate Index is accepted.
4 - 5	Date of Test: Day	1 through 31 only.
6 - 7	Date of Test: Month	1 through 12 only.
8 - 9	Date of Test: Year	68 through 73. Extended annually on 1 January.
10 - 18	Item: Social Security Number	Must have digits entered (greater than 1).
19 - 24	Facility Code, Place of Test	Currently 066596 (NSMRL) or 55522 (DEVGRU I). Others to be added as appropriate.
25 - 26	Date of Birth: Day	1 to 31
27 - 28	Date of Birth: Month	1 to 12
29 - 30	Date of Birth: Year	10 through 56 only.
31 - 80	Data Entries of The Examination Phase.	Various Limits: Absolute: a. Only possible numerical values accepted. Relative: b. Only reasonable (approximately 3.0 s.d.) values accepted. c. Ratios and relationships of some variables are tested; rejected if not reasonable.

FIGURE 2: LONGITUDINAL HEALTH SURVEY DATA SYSTEM



processing of acquired data through the entire system, error editing, storage and analysis.

Appendix A contains a copy of a POOPS analysis of pulmonary function data showing listing of parameters and indication of errors or data which exceeds expected values.

INDEX 001 BACKGROUND

This section of the Longitudinal Health Survey is devoted to the listing of personal identification information and appropriate demographic data. The information elicited is described in the following listing.

Table VI: Data Description for LHS Index 001: Background

Data Sheet/ Card Columns	Data Description	Poops Limits
1 - 3	001 designates Index as Background.	001
4 - 30	Identification of person, place, time: as previously described (Table 4).	
31 - 50	The subject's name in last-first-initial order is listed in a 20 column space for both identification and labeling services. This section and the roentgenography Index (015) are the only two such listings in the LHS data system.	NONE
51 - 54	Occupational, military. Status at time of examination. This descriptive designator is referenced from BUMED INST 6310.8, enclosure (2) Page 25-27: Patient category codes.	0 - 1999
55 - 56	If military, defines pay grade as listed. BUMED INST 6310.8, enclosure (2), Page 23.	1 - 45
57 - 58	An estimate of total years of military service. This is life-time total, active duty only.	0 - 40
59 - 74	Special military qualifications, U.S. Navy. Allows for multiple special qualification indication.	0, 1

Table VI: Data Description for LHS Index 001: Background (Cont)

Data Sheet/ Card Columns	Data Description	Poops Limits
75 - 76	Geographic origin: State of U.S. Reference BUMED INST 6310.8, enclosure (2), pp 13-19.	1 - 56
77 - 78	Geographic Origin: Foreign country. Reference BUMED INST 6310.8.	None
79 - 80	Approximate family size with which individual lived prior to age 16. Of significance in psychological evaluation, antibody studies, and elsewhere.	1-20, 99

The essentials of demographic information such as occupation, training, economic level, geographic origin, and family size have been included in this action. More detailed information is not considered necessary for our purposes. A number of additions to this data site are presently under consideration. Environmental data such as atmospheric control excursions, radiation information, and number of nuclear submarine patrols are examples of these anticipated additions.

LHS: BACKGROUND (1)
REF: BUMEDINST 6310.8A

NAME:

LAST FIRST INITIAL

INDEX

0	0	1
1	2	3

TODAY'S DATE: DAY (4 5) MONTH (6 7) YEAR (8 9)

SOCIAL SECURITY NO.: (10 11 12) (13 14) (15 16 17 18)

BUMED INST. 6310.8A
FACILITY CODE: NSMRL

0	6	6	5	9	6
19	20	21	22	23	24

DATE OF BIRTH: DAY (25 26) MONTH (27 28) YEAR (29 30)

NAME: 1. PLEASE WRITE IN LAST-FIRST-INITIAL ORDER, BEGIN AT BOX 31.
2. SEPARATE WORDS OF NAME BY ONE SPACE.
3. LEAVE BLANK FOR APOSTROPHE OR BREAK IN NAME (MC_DUFF, D_GATI).
4. NO MIDDLE NAME: (N)

LAST NAME IN CAPS:

(31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50)

STATUS AT PRESENT:

MILITARY BRANCH, CIVILIAN, ETC. _____.

REGULAR, RESERVE, RETIRED: _____.

DO NOT FILL IN (51 52 53 54)

MILITARY PAY GRADE: E ☐ OR O ☐

PAY GRADE CODE
DO NOT FILL IN ☐☐ 55 56

MILITARY SERVICE: ENTER TOTAL YEARS OF SERVICE: ☐☐ 57 58

SPECIAL QUALIFICATION: PLEASE CHECK APPROPRIATE BOXES. (MAY BE MORE THAN ONE):
(CODER: USE 1 PUNCH FOR ALL CHECKS)

NONE	☐	59	DIVER: SCUBA	☐	67
AIRCREW, MEMBER	☐	60	DIVER: 2nd CLASS	☐	68
AIRCREW, NONMEMBER	☐	61	DIVER: 1st CLASS	☐	69
PARACHUTIST	☐	62	DIVER: SATURATION	☐	70
SUBMARINER	☐	63	DIVER: MASTER	☐	71
SUBMERSIBLE OPERATION	☐	64	ACCELERATION, DECELERATION	☐	72
DEMOLITION OF EXPLOSIVES	☐	65	THERMAL TESTING	☐	73
CHAMBER, INSIDE TENDER	☐	66	OTHER	☐	74

PLACE OF ORIGIN:

WRITE NAME OF STATE (OR FOREIGN COUNTRY) WHERE YOU SPENT MAJOR PORTION OF YOUR LIFE PRIOR TO AGE 16: (BUMEDINST 6310.8A)

_____

DO NOT FILL IN ☐☐☐☐
75 76 STATE | 77 78 FOREIGN COUNTRY

FAMILY SIZE: APPROXIMATE NUMBER OF PEOPLE (ADULTS AND CHILDREN) IN YOUR FAMILY (OR OTHER GROUP) WITH WHICH YOU LIVED PRIOR TO AGE 16. (PLACE TOTAL IN BOXES)
(EXCEPTION, SUCH AS ORPHANS IN INSTITUTIONS, MARK 99) ☐☐ 79 80

☐ K.P.

8/72

INDEX 011 PSYCHOLOGICAL/SOCIAL

This section of the Longitudinal Health Survey is concerned with the recording or data which may determine personality adjustment and behavior.

The MMPI test consists of 566 true-false statements. The test can be administered individually or in groups in one to two hours. Professional psychologists are not necessary for administration, and the test can be

Table VII: Data Description for LHS Index 011: Psychological/Social

Data Sheet/ Card Columns	Data Description	Poops Limits
1 - 3	011 designates Index as Psychological/ Social.	011
4 - 30	Identification of person, place, time: as previously described (Table 4).	
31 - 58	Results of the Minnesota Multiphasic Personality Inventory (MMPI). Basic data includes the K correction but has not been converted to T-scores. The data are the ten diagnostic & four validation scales.	
31 - 32	? Validation Score	0 - 99
33 - 34	L Validation Score.	0 - 15
35 - 36	F Validation Score	0 - 64
37 - 38	K Correction Factor	0 - 33
39 - 40	Hs Hypochondriasis	0 - 33
41 - 42	D Depression	0 - 60
43 - 44	Hy Hysteria	0 - 60

Table VII: Data Description for LHS Index 011: Psychological/Social (Cont)

Data Sheet/ Card Columns	Data Description	Poops Limits
45 - 46	Pd Psychopathic	0 - 50
47 - 48	Mf Masculinity-femininity	0 - 60
49 - 50	Pa Paranoia	0 - 40
51 - 52	Pt Psychasthenia	0 - 48
53 - 54	Sc Schizophrenia	0 - 78
55 - 56	Ma Hypomania	0 - 46
57 - 58	Si Social Introversion	0 - 70
59 - 60	GCT Score	30 - 75
61 - 62	Total Years of civilian schooling	9 - 20
63	Indication of hand dominance	1, 2, 3
64	Number of marriages in lifetime	0 - 4
65	Number of natural children, male.	0 - 5
66	Number of natural children, female.	0 - 5
78 - 80	Groups of individuals from a given source or activity (e.g., diving class) often are processed. This three digit code provides an easy reference point in a permanent log of such groups. An example is the entire saturation diving class at San Diego examined in April 1972, coded as 105.	1 - 999

administered anywhere there is a writing surface. The MMPI can be hand or machine scored (IBM 805, 1230 or 1232). Test reliability is good (.46 - .91 for the various scales).[13,14,15,16]

At present the MMPI is administered to small groups (3-5 individuals) in a small testing room. Hand scoring with templates is the presently used method, and takes approximately five minutes per protocol.

Although there are a number of test yielding psychological parameters, it is strongly felt that the MMPI is the most appropriate for the LHS. It is easily administered and scored, widely available and used, and heavily referenced. Further, machine interpretation and scoring techniques are available for the MMPI with large numbers of subjects. Such machine processing of MMPI information will be considered. General Classification Test scores, schooling information, and marital history should yield significant comparison. This section contains child birth and sex information which may finally answer the clichés concerning sex distribution of children of divers.

LHS:
PSYCHOLOGICAL/SOCIAL

NAME:

LAST FIRST MIDDLE

INDEX

0	1	1
1	2	3

TODAY'S DATE; DAY (4 5) MONTH (6 7) YEAR (8 9)

SOCIAL SECURITY NO.: (10 11 12) (13 14) (15 16 17 18)

BUMED INST. 6310.8A
FACILITY CODE PLACE: SUBMEDCEN

0	6	6	5	9	6
19	20	21	22	23	24

DATE OF BIRTH: DAY (25 26) MONTH (27 28) YEAR (29 30)

1. MMPI: BASIC DATA, WITHOUT CONVERSION

?	L	F	K	H_s	D	H_y
31 32	33 34	35 36	37 38	39 40	41 42	43 44

P_d	M_f	P_a	P_x	S_c	H_a	S_i
45 46	47 48	49 50	51 52	53 54	55 56	57 58

2. GCT: (59 60)

3. EDUCATION, SCHOOLING: TOTAL YEARS OF CIVILIAN SCHOOLING (61 62)

3/72

4. HANDED: RIGHT: 1 AMBIDEXTROUS: 3 [ ] 63
LEFT : 2

5. NUMBER OF MARRIAGES: [ ] 64

6. NUMBER OF NATURAL MALE CHILDREN [ ] 65
IF OVER 9, ENTER 9

7. NUMBER OF NATURAL FEMALE CHILDREN [ ] 66
IF OVER 9, ENTER 9

Study Group [ ][ ][ ] 78 79 80

[ ]
K.P.

8/72

INDEX 013 - MORTALITY INFORMATION

This is a brief section which indicates that an LHS subject has died, and lists the causes of death, and whether autopsy information is available.

For proper functioning of this section as to cause of death of LHS study subjects, a procedure at BUMED level will be necessary to transmit mortality information, perhaps on the entire U.S. Navy submarine and diving population, to a central facility for LHS membership screening. The determination of this procedure and its implementation remain as a task of the future.

This section contains the final entry information for LHS subjects. A review of death certificates from 38 states was made, and the data formed was designed to accept significant information on the causes of death.

Table VIII: Data Description For LHS Index 013 - Mortality

Data Sheet/ Card Columns	Data Description	Poops Limits
1 - 3	013 designates Index as mortality.	013
4 - 30	Identification of person, place, time as previously described (Table IV)	
31	Autopsy Information. Indicates whether or not autopsy has been done. If done, whether NSMRL has possession of autopsy results.	1 - 3
32 - 37	Date of death.	
38 - 53	If known, primary and secondary causes of death. The format varies significantly between states. This section of the form is designed to retain the most information and still accommodate the various reporting methods. Coded in accordance with BUMED INSTRUCTION 6310.8.[10]	Greater than zero
54 - 66	A 13-digit area to accommodate last name of individual for cross-filing or search purposes.	NONE

LHS: MORTALITY

NAME:

LAST FIRST INITIAL

INDEX

0	1	3
1	2	3

TODAY'S DATE: DAY (4 5) MONTH (6 7) YEAR (8 9)

SOCIAL SECURITY NO.: (10 11 12) (13 14) (15 16 17 18)

BUMED INST. 6310.8A
FACILITY CODE PLACE: NSMRL

0	6	6	5	9	6
19	20	21	22	23	24

DATE OF BIRTH: DAY (25 26) MONTH (27 28) YEAR (29 30)

AUTOPSY: (31)

UNKNOWN: BLANK
NONE: 1
PERFORMED: 2
PERFORMED, REPORT IN FILE: 3

DATE OF DEATH: DAY (32 33) MONTH (34 35) YEAR (36 37)

DO NOT FILL IN (38 39 40 41) (42 43 44 45) (46 47 48 49) (50 51 52 53)

1a. CAUSE: _____

1b. CAUSE: _____

2a . DUE TO _____

2b DUE TO _____

LAST NAME: (54 55 56 57 58 59 60 61 62 63 64 65 66)

(66) K.P.

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INDEX 015: ANTHROPOMETRIC MEASUREMENTS

Anthropometric measurements may be taken and analyzed in many ways.[17, 18, 19, 20] The optimum method will depend upon the end sought and the practical possibilities for accurate measurement. The major consultant in this area of anthropometry was Mr. R. WHITE, of the Anthropometric Section, Army Environmental Laboratory of Natick, Massachusetts. A number of visits were made to the Natick, Mass., Laboratory site. Conferences were held with Mr. White to select a reasonable number of variables, and in diagnosing errors in measurement committed in previous studies. With the objectives of obtaining data of medical significance and also of suit-fitting value for submarine escape, 14 measurements were selected.[20] These measurements are described in Table IX, and then shown in the self-explanatory Index 015 for which follows:

Table IX: Data Description For Index 015: Anthropometry

Data Sheet/ Card Columns	Data Description	Poops Limits
1 - 3	015 designates Index as Anthropometric.	015
4 - 30	Identification of person, place, time; as previously described (Table IV).	
31 - 33	Weight: The subject is weighed on spring scales, to nearest pound, while wearing only undershorts.	110 - 300
34 - 37	Stature: Subject stands erect, with heels together and head level. Stature is measured in millimeters as the vertical distance from the top of the head (vertex). An anthropometer is used, with the anthropometer arm firmly touching the scalp to compress the hair.	1500 - 2000

Table IX: Data Description For Index 015: Anthropometry (Cont)

Data Sheet/ Card Columns	Data Description	Poops Limits
38 - 41	Functional Reach: Subject stands erect against a wall, with his right arm extended forward horizontally, and with the tip of his thumb and index finger pressed together; his scapulae remains touching wall. Functional reach is measured, with anthropometer, as the horizontal distance from the wall to the outer edge of junction of tips of thumb and forefinger.	650 - 1000
42 - 45	Sitting Height: Subject sits erect, with head level, and with his feet resting on a surface adjusted so that his knees are bent at right angles. Sitting height is measured as the vertical distance from the sitting surface to the top of the head (vertex). The anthropometer arm is held firmly on the scalp to compress the hair.	750 - 1050
46 - 48	Chest Depth: Subject stands erect, with his arms initially raised and then lowered after the anthropometer is in place under the right arm. The depth of the chest is measured at the level of the nipples during normal breathing.	150 - 350
49 - 51	Chest Breadth: Subject stands erect, with his arms initially raised and then lowered after the anthropometer is in place. The breadth of the chest is measured at the level of the nipples during normal breathing.	250 - 425
52 - 54	Shoulder Breadth: (Bideltoid Breadth): Subject sits erect, with his arms bent to form right angles at the elbows and with his elbows held against the body. The maximum breadth across the shoulders is measured at the level of the bulges of the deltoid muscles in the upper arms.	350 - 600

Table IX: Data Description For Index 015: Anthropometry (Cont)

Data Sheet/ Card Columns	Data Description	Poops Limits
55 - 57	Hand Length: Subject sits, with his right hand and fingers extended, palm up. The length of the right hand is measured from the wrist crease to the tip of the middle finger with sliding calipers.	150 - 250
58 - 60	Hand Breadth: Subject sits, with his right hand and fingers extended, palm up. The breadth of the hand is measured at the level of the knuckles (distal ends of the metacarpal bones) with sliding calipers.	70 - 110
61	Longer Toe. Indicates whether first or second toe is longer.	1,2
62 - 64	Foot Length: Subject stands erect, with his weight evenly distributed on both feet. The maximum length of the right foot is measured from the back of the heel to the tip of the longest toe.	210 - 330
65 - 68	Chest Circumference: Subject stands erect with his arms initially raised and then lowered after the tape is in place. The maximum horizontal circumference of the chest is measured with a steel tape at the level of the nipples at full inspiration.	850 - 1400
69 - 72	Chest Circumference: Subject stands erect, with his arms initially raised and then lowered after the tape is in place. The maximum horizontal circumference of the chest is measured at the level of the nipples at full expiration with a steel tape.	700 - 1200

Table IX: Data Description For Index 015: Anthropometry (Cont)

Data Sheet/ Card Columns	Data Description	Poops Limits
73 - 76	Waist Circumference: Subject stands erect, with abdomen relaxed. The maximum horizontal circumference of the waist is measured with a steel tape at the level of the umbilicus.	600 - 1300
77 - 80	Vertical Trunk Circumference: Subject stands erect, with his feet slightly apart. The vertical circumference of the trunk is measured with a steel tape passed through the crotch, to right of scrotum and over the midpoints of the right buttock and right shoulder.	1350 - 2000

Prior to 1967 there were no studies exclusively designed to compile and analyze anthropometric data originating from the submariner and diver population of the U. S. Navy. However, in 1949, an abridged battery of 13 anthropometric measures were obtained as part of a factor analysis of 164 variables collected from 88 enlisted submariner candidates. The primary objective of this study (Cook & Wherry, 1949)[17-a] was to identify the major classes of psychobiological processes characterizing enlisted men who had volunteered for the submarine service at that time. A secondary population was selected for biochemical endocrinological, physiological, physiognomic, anthropometric, and psychological measures. All measurements were done by medical officers and senior hospital corpsmen who had been exposed to comprehensive training courses specifically designed to cover each of the measurement procedures (including anthropometric). Frequency distributions for each of the 164 variables were first produced. Then a first order 164 x 164 correlation matrix was computed; this matrix in turn was subjected to an orthogonal factor analysis. While selected segments of the results were published in professional journals, all of the matrix information and normative data may be found in Cook,[17] 1961.

The specific need for anthropometric data was reemphasized in 1966, in view of the fact that submarine escape, survival and rescue was considered a vital study area for the Naval Submarine Medical Research Laboratory. After consulting with the U.S. Army Pioneer Laboratories at Natick, Massachusetts, it was found that data had been secured on all military groups in the Department of Defense, except

submarine and diving personnel. The responsible Department at the Army Pioneer Laboratory, Natick, was most anxious to obtain anthropometric data on submarine and diving personnel, and offered to assist the NSMRL in any way possible. After securing the necessary anthropometric measuring devices, a study was set up at the NSMRL, with Natick's help, for the specific purpose of securing the aforementioned anthropometric data.

Following the inauguration of the Longitudinal Health Study as a study unit, it was considered that the anthropometric measurements could be included in the LHS, and the necessary mensuration data could be thus acquired. Inasmuch as the anthropometric measurements in use at NSMRL had been established by Mr. White of the Natick Laboratory, and consisted of more than 100 measurements, a reduction in the number of these measurements was necessary. Considering the general needs, the time restrictions and overall requirements, 14 significant measurements were selected by the LHS staff on the advice of Mr. White. Familiarity and training are essential for correct and accurate measurements. Large errors are possible since most examining personnel are unfamiliar with the metric measurement system. Small errors are quite common with untrained examiners, whose technique may differ significantly. Measurements at present are conducted by a single examiner who has been personally trained by Mr. White, who is the authority in anthropometry at the Army Pioneer Laboratory at Natick, Massachusetts.

LHS: ANTHROPOMETRIC (1)

NAME:

LAST FIRST INITIAL

INDEX

0	1	5
1	2	3

TODAY'S DATE: DAY (4 5) MONTH (6 7) YEAR (8 9)

SOCIAL SECURITY NO.: (10 11 12) (13 14) (15 16 17 18)

BUMED INST. 6310.8A
FACILITY CODE PLACE: NSMRL

0	6	6	5	9	6
19	20	21	22	23	24

DATE OF BIRTH: DAY (25 26) MONTH (27 28) YEAR (29 30)

Station #1 - Scales

WEIGHT (To nearest pound) (31 32 33) pounds

LIGHT CONTACT IN ALL, DO NOT INDENT TISSUE IN MEASURING. ENTER COMMENTS

STATURE: Standing, measure from behind. (34 35 36 37) Millimeters (1500-2000)

FUNCTIONAL REACH: from wall to thumb/index junction, standing. (38 39 40 41) Millimeters (650-1000)

SITTING HEIGHT: From behind, half meter. (42 43 44 45) Millimeters (750-1050)

Standing

CHEST DEPTH - AP distance at rest, at nipple line. Meter underarm include scapula. (46 47 48) Millimeters (150-350)

CHEST BREADTH - At nipple line, resting. (49 50 51) Millimeters (250-425)

SHOULDER BREADTH (BIDELTOID): Greatest bulge arm hanging free. (52 53 54) Millimeters (350-600)

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Sliding calipers

HAND LENGTH (From wrist skin fold) (Right) [ ][ ][ ] 55 56 57 Millimeters (150-250)

HAND BREADTH (METACARPALS) (Right, diagonal) [ ][ ][ ] 58 59 60 Millimeters (70-110)

Standing; foot board - right foot (1 / 2)

TOE LENGTH - 1st toe longer / 2nd toe longer [ ] 61 (Enter number)

FOOT LENGTH - To longest toe [ ][ ][ ] 62 63 64 Millimeters (210-330)

Station #3 - Standing; tape (Keep tape level, snug fit, check tape)

CHEST CIRCUMFERENCE at nipple - Forced inspiration [ ][ ][ ][ ] 65 66 67 68 Millimeters (850-1400)

CHEST CIRCUMFERENCE at nipple - Forced expiration [ ][ ][ ][ ] 69 70 71 72 Millimeters (700-1200)

ABDOMEN CIRCUMFERENCE at umbilicus, resting [ ][ ][ ][ ] 73 74 75 76 Millimeters (600-1300)

Station #6 - Standing on floor; tape

VERTICAL TRUNK CIRCUMFERENCE, over right shoulder [ ][ ][ ][ ] 77 78 79 80 Millimeters (1350-2000)
To right side of scrotum.
Midway shoulder.
Push tape with hand against small of back.

[ ]
K. P.
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INDEX 020: ROENTGENOGRAPHY

This section provides information as to type of examination performed, and general diagnostic categories.[21]

TABLE X describes the roentgenography data section, and is followed by the self-explanatory form.

At present, this section will accept the general data on results of chest roentgenography and bone surveys. It also contains the subject's name in last, first, middle initial order. This index has been designed in coordination with the Diving Medicine Branch of NAVSUBMEDRSCHLAB for coding of bone survey information. Thus, the

Table X: Data Description For Index 020: Roentgenography

Data Sheet/ Card Columns	Data Description	Poops Limits
1 - 3	020 designates Index as roentgenography.	020
4 - 30	Identification of person, place, time; as previously described (Table IV).	
31 - 50	Provides 20 columns for recording patient's name in last, first, initial order. The usual methods of filing roentgenography films are by Social Security number or by name, this index provides information on both.	NONE
51	Indicates performance of chest roentgenography examination. Further indicates type of examination, whether PA or PA & Lateral. Expansion space provided for coding of other special chest studies.	0 - 2
52 - 54	LHS coding of results of chest examination by general class. At present this includes four categories with ample expansion space. Coding categories are indicated in the following form.	0 - 4
55 - 56	Indicates that bone survey views have been made for presence of aseptic necrosis. A 2-digit field is provided not only to designate such a survey has been performed, but that space is also provided for the indication of specific bone survey protocol used. A specimen protocol is provided in Appendix B.	0 - 2

Table X: Data Description For Index 020: Roentgenography (Cont)

Data Sheet/ Card Columns	Data Description	Poops Limits
57 - 59	Results of bone survey of aseptic necrosis. At present, this includes only positive and negative indication of diagnosis. Ample expansion coding space has been provided with the 3-digit LHS code.	0 - 2
Linked-Error Sub Routine: Indicates error is result of either chest roentgenography or bone survey appearing on data card without corresponding indication of performance of the examination. The converse, however, is not considered an error. For instance, a bone survey procedure may have been completed, but results not recorded due to delay in reading and interpretation.		L.E.

time, place protocol and results of a bone survey may be entered. To date this LHS data section has listed the bone surveys done on all diving personnel, but does not list all the results of the x-rays. Results will be available as soon as interpretation of the films is standardized and validated. It will then be included.

LHS: ROENTGENOGRAPHY

NAME:

LAST FIRST INITIAL

INDEX: 0 2 0 (1 2 3)

X-RAY DATE: DAY (4 5) MONTH (6 7) YEAR (8 9)

SOCIAL SECURITY NO.: (10 11 12 13 14 15 16 17 18)

BUMED INST. 6310.8A
FACILITY CODE PLACE: NSMRL

DATE OF BIRTH: 0 6 6 5 9 6 (19 20 21 22 23 24)
DAY (25 26) MONTH (27 28) YEAR (29 30)

NAME:
1. PLEASE WRITE IN LAST-FIRST-INITIAL ORDER, BEGIN AT BOX 31.
2. SEPARATE WORDS OF NAME BY ONE SPACE.
3. LEAVE BLANK FOR APOSTROPHE OR BREAK IN NAME (MC_DUFF, D_GATI)
4. NO MIDDLE NAME (N).

(31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50)

EXAMINATION

1. CHEST: P.A. ONLY (1)
PA & LAT: (2) (51)
OTHER _____

NOTE: TECH. UNSAT: No Code, No Punch.

RESULT (52 53 54)

WNL: (001)
Old Calcification (of any type): (002)
Any Cardiomegaly (003)
Other Abnormalities (004)

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2. BONE SURVEY FOR ASEPTIC NECROSIS: (Enter 1) [ ][ ] 55 56

Negative to Aseptic Necrosis: 01

Aseptic Necrosis Present: 02

[ ][ ][ ] 57 58 59

NOTE: Tech. Unsat: No Code, No Punch.

[ ] K.P.

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INDEX 021 - DENTAL

Dental health is best defined by obtaining accurate, reproducible intraoral measurements and establishing acceptable diagnostic criteria. Unfortunately, there is no unanimity of opinion fixing such diagnostic criteria. However, commonly accepted methods of reproducible intraoral measurements have been used in the dental section of the LHS, with the concept of obtaining data of permanent relevance.

Table XI: Data Description For LHS Index 021 - Dental

Data Sheet/ Card Columns	Data Description		Poops Limits
1 - 3	021 designates Index as dental.		021
4 - 30	Identification of person, place, time as previously described (Table 4).		
31 - 32	DMFT	The oral condition of each subject is characterized by recording whole	0 - 32
33 - 35	DMFS	mouth, DMFT (decayed, missing, filled teeth), and DMFS (decayed,	0 - 160
36 - 37	Carious	missing, filled surfaces), number of carious teeth, number of re-	0 - 32
38 - 39	Restored	stored teeth, and number of missing teeth. These indices	0 - 32
40 - 41	Missing	are historically accepted as significant and appropriate. Third Molars are not counted. The number of carious teeth are those with clinically open caries.	0 - 32
42 - 43	Russell's Index: A scoring system for periodontal condition using the Periodontal Index (P.I.) of Russell.[22] This system uses graded stages from normal through incipient disease, through moderate and advanced disease, to a terminal situation where remedial treatment would be ineffectual. This system does not indicate specific teeth or the degree of damage to any specific area. It is the average of all teeth including third molars. The score in the LHS is rounded to one decimal point.		0 - 80

Table XI: Data Description For LHS Index 021 - Dental (Cont)

Data Sheet/ Card Columns	Data Description	Poops Limits
44 - 45	Number of Pockets. This is arrived at in conjunction with Russell's Index and is an indication of existing disease.	0 - 32
46 - 47	Area of Gingivitis: Calculated along with Russell's Index and closely related in determination of periodontal disease. Pockets are ignored in this scoring, which is performed on every tooth.	0 - 20
48 - 49	Debris Score: The oral hygiene index of Greene and Vermillion[23] is the most widely used index for individual or group hygiene. It has been used extensively in the Public Health Service[24] and was used in formulating the U. S. Navy periodontal screening examination.	0 - 30
(50 - 67)	The Periodontal Disease Index (P.D.I.) of S. P. Ramfjord[25] modified by W. R. Shiller[25-a] of NSMRL offers an acceptable and rapid assessment of the periodontal status of the individual.	
50 - 61	Pocket or Sulcus depth for 6 teeth: Nos. 3, 9, 12, 19, 25, 28.	0 - 6
62 - 67	Plaque extent measurement on enamel surface adjacent to the measured sulcus.	0 - 3

It is anticipated that subtle individual changes with time may be recorded in this fashion. The use of the P. I. and the P.D.I. are well supported in the literature[26,27] and have gained considerable acceptance, most notably in large surveys by the U.S. Public Health Service.

Full-mouth impressions are taken followed by the pouring of casts. Color photographs are also taken. It is

anticipated that the mouth models and photographs will graphically record with time the changes occurring within each subject's mouth.

The data contained in the dental section represents a compromise in concepts. Some students of the LHS deny the importance of any dental section while others recommend that it be expanded. The problem is to restrict the amount of time expended while still collecting reproducible and epidemiological data of importance. It is the opinion of the LHS staff that the present Index 021 is an acceptable and reasonable requirement for this study.

LHS: DENTAL

NAME:

LAST FIRST INITIAL

INDEX: 0 2 1 (1 2 3)

TODAY'S DATE: DAY (4 5) MONTH (6 7) YEAR (8 9)

SOCIAL SECURITY NO.: (10 11 12) (13 14) (15 16 17 18)

BUMED INST. 6310.8A
FACILITY CODE PLACE: NSMRL

0 6 6 5 9 6 (19 20 21 22 23 24)

DATE OF BIRTH: DAY (25 26) MONTH (27 28) YEAR (29 30)

DMFT	DMFS	CARIES	RESTORED TEETH	MISSING TEETH	RUSSEL'S INDEX	NUMBER POCKETS
(31 32)	(33 34 35)	(36 37)	(38 39)	(40 41)	(42 43)	(44 45)

AREA GINGIVITIS	DEBRIS SCORE
(46 47)	(48 49)

RAMJFORD INDEX (Shiller modification)

TOOTH NUMBER

	#3	#9	#12	#19	#25	#28
MESIAL Number:	(50 51)	(52 53)	(54 55)	(56 57)	(58 59)	(60 61)
PLAQUE MESIAL Number:	(62)	(63)	(64)	(65)	(66)	(67)

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INDEX 025: PULMONARY FUNCTION

The occupational environments of both submariner and diver may cause adverse effects on pulmonary function. The increased density, breathing resistance, and the decompression effects upon the pulmonary system add even more significance to the situation of the diver.

The tests of pulmonary function utilized in this Index are established and well documented.[28,29,30]

Table XII: Data Description for LHS Index 025: Pulmonary Function

Data Sheet/ Card Columns	Data Description	Poops Limits
1 - 3	025 designates Index as Pulmonary Function.	025
4 - 30	Identification of person, place, time; as previously described (Table IV).	
31 - 32	Age of subject in years.	15 - 60
33 - 35	Weight of subject in kilograms	50 - 140
36 - 37	Height of subject in inches	50 - 80
38 - 40	FVC, Forced Vital Capacity. (liters) Gradual decrease expected with age.	3.0 - 7.0
41 - 43	FEV 1, and	2.0 - 6.0
44 - 46	FEV 2. Forced Expiratory Volume, 1 second and 2 seconds, respectively, expressed in liters.	3.0 - 6.5
47 - 50	MEFR: Maximal Expiratory Flow Rate (liters per second).	7.0 - 13.0
51 - 53	MVV: Maximum Voluntary Ventilation (liters per minute).	100 - 200
54 - 56	Expiratory Reserve Volume (liters). In this study it is measured primarily to allow the determination of residual volume by subtraction RV = FRC - ERV.	0.5 - 3.0

Table XII: Data Description for LHS Index 025: Pulmonary Function (Cont)

Data Sheet/ Card Columns	Data Description	Poops Limits
57 - 59	RV: Residual Volume (liters). Calculated by subtracting ERV (spirometer) from the FRC (plethysmograph).	0.7 - 3.0
60 - 62	FRC: Functional Residual Capacity (liters). Measured functional residual capacity (liters).	1.2 - 5.0
63 - 66	Raw: Airway resistance (centimeters H_2O/ L/Sec.). This is measured in the body plethysmograph by panting with the shutter open. It increases very slightly with advancing age, greatly in obstructive disease, and may increase somewhat in restrictive disease patterns.	0.6 - 3.0
67 - 69	MMF: Maximum Midexpiratory Flow (L/Sec). This is the expiratory flow rate during the middle 50% of the vital capacity effort. Eliminated from consideration are the first 1/4 of the volume where rate of flow may be unduly low (patient hesitation or spirometer inertia) or unduly high (emphysema before "trapping" occurs) and the last 1/4 of the vital capacity (not ordinarily used during stress).	3.6 - 6.7
SUB-ROUTINES FROM RECORDED DATA		
R1:	FEV1/FVC: The ratio of the 1-second Forced Expiratory Volume as a proportion of the Forced Vital Capacity.	.75 - .98
R2:	FEV2/FVC: The ratio of the 2-second Forced Expiratory Volume as a proportion of the Forced Vital Capacity.	.88 - 1.00
R3:	RV/TLC: TLC computed as sum of RV and FVC.	.10 - .30

METHOD The FBC, FEV1, FEV2, MEFR are all measured using a single forced expiration following a maximal inspiration, utilizing a wedge spirometer (Med Science Electronics Model 370 with model 280 pulmodigitizer).

The MVV is measured during a 14-second prior with the wedge spirometer, pulmodigitizer and Model 281 MVV computer (Med Science Electronics). The ERV measurement utilizes both the wedge spirometer and pulmodigitizer; the subject breath holds for a short period of time at the resting and expiratory position (FRC volume), and then obtaining a maximal expiration with maximally increased equipment sensitivity.

Each test described using the wedge spirometer is performed at least twice; and the result judged most valid is the one saved for record. The judgment is made by an experienced cardiopulmonary technician.

The FRC and Raw are measured by the method of Dubois, using a Collins Plethysmograph System (Model P-2601, 2602, 2603, 2604), utilizing a Hewlett Packard Power Supply (Model 8848A), Carrier preamplifier (HP Model 8805A), and a Tektronic Storage Oscilloscope (Model R-564 B) with two differential amplifier plug-ins, attached to each unit (Tektronic Type 2A63). The procedure is repeated for a total of five usable determinations. Values are averaged, discarding those with large scatter or those with questionable contours in the scope tracing. The angles are measured from the stored image with a modified Hewlett-Packard scope protractor and the FRC and Raw are calculated.

This section has yielded a considerable amount of significant medical information.. It alone is an excellent argument for the continuation of the LHS. Obstructive pulmonary disease has been discovered in a number of LHS subjects who have been randomly selected for processing through the study. The pulmonary function section combined in analysis with habits, individual history, family history and chemistries should prove a highly valuable area of investigation.

The computer calculated ratios, as listed in Table XII, and their inclusion in the POOPS system has proven to be highly effective. In identifying results of possible pathological significance, consultation with authorities in the field of pulmonary function indicate that N_2 washout techniques should be included in the LHS pulmonary function methodolgy.[31] Appropriate equipment is currently on order to accomplish this.

LHS: PULMONARY FUNCTION

NAME:

LAST FIRST INITIAL

INDEX: 0 2 5 (1 2 3)

TODAY'S DATE: DAY (4 5) MONTH (6 7) YEAR (8 9)

SOCIAL SECURITY NO.: (10 11 12) (13 14) (15 16 17 18)

BUMED INST. 6310.8A
FACILITY CODE PLACE: NSMRL

0 6 6 5 9 6 (19 20 21 22 23 24)

DATE OF BIRTH: DAY (25 26) MONTH (27 28) YEAR (29 30)

AGE: (31 32) YRS.

*WEIGHT: (33 34 35) *KILO

HEIGHT: (36 37) IN.

FVC (38 39 40)

FEV 1 (41 42 43)

FEV 2 (44 45 46)

MEFR (47 48 49 50)

MVV (51 52 53)

ERV (54 55 56)

RV (57 58 59)

FRC (60 61 62)

Raw (63 64 65 66)

MMF 25-75% (67 68 69)

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INDEX 031 - 034: AUDIOMETRY

The audiometry testing protocol is outline below in Table XIII and illustrated further in the following data sheet.

This section contains evaluation of air conduction, bone conduction, pitch memory and high frequency response. Besides providing testing in the usual, functional frequency ranges, it is anticipated that significant information

Table XIII: Data Description For LHS Index 031-034: Audiometry

Data Sheet/ Card Columns	Data Description	Poops Limits
1 - 3	031 designates index as audiometry.	031
4 - 30	Identification of person, place, time; as previously described (Table IV).	
31 - 78	Air-Conduction Audiometry. (dB) Pure Tone air-conduction audiometry is utilized. Frequencies from 500 to 8,000 Hertz are used. With these tones a very little aging loss is shown in the testing of men to the fourth decade of life.[33]	KH / SUBS / DIVERS 0.5 / 25 / 25 1.0 / 25 / 25 1.5 / 99 / 25 2.0 / 25 / 25 3.0 / 45 / 99 4.0 / 99 / 40 6.0 / 99 / 99 8.0 / 99 / 99 (-20 dB lower limit for all)
79 - 80	Skipped for continuity.	
INDEX 032		
1 - 3	032 indicates the second data sheet/card of audiometry testing section.	
4 - 18	Repeat as from Index 031.	

Table XIII: Data Description for LHS Index 031-034: Audiometry (Cont)

Data Sheet/ Card Columns	Data Description	Poops Limits
19 - 54	Bone-Conduction Audiometry. A bone-conduction vibrator is placed on the mastoid. The opposite ear is masked since such bone-conductive tones may be transmitted to the opposite ear through the skull. Bone-conduction tests are used in the assessment of sensorineural mechanisms.[34,35] The Frequencies used are 500 to 4,000 Hertz.	KC / SUBS / DIVERS 0.5 / 25 / 25 1.0 / 25 / 25 1.5 / 99 / 25 2.0 / 25 / 25 3.0 / 45 / 99 4.8 / 99 / 40 (-20 lower limit for all)
55 - 56	Pitch Memory: The standard frequency is 1150 Hertz. There are two tones at each of 100 items as described below. The pitch of the second tone is compared to the pitch of the first.[36,37]	0 - 10
INDEX 032:	57 - 80	
INDEX 033:	19 - 80	
INDEX 034:	19 - 24	
	High Frequency Audiometry, includes 4-18 kHz. There is a decrease in high frequency hearing of approximately 10 decibels per decade of life after the age of 25. High frequency losses may also be due to acoustic trauma and use of certain drugs.[34] It has been described as "where the action is" in hearing loss, and thus is of great interest in the LHS system.	-20 to 99

AUDIOMETRIC TESTING EQUIPMENT LIST

TEST	EQUIPMENT
Air Conduction Test	Maico, Model MA-24, Audiometer
Bone Conduction Test	Maico, Model MA-24, Audiometer
Pitch Memory Test	Ampex, Model 766, Tape Recorder - Monaural; listening with TDH phone in an Otocup Earmuff.
High Frequency Test	Rudmose, Model RA-114m H.F. Audiometer.

will be obtained from the high frequency spectrum of audiometric testing.

The coding sheet for this Index is the most cumbersome of the LHS data-system. Accommodation was necessary for negative values, the usual variable range, and also no response. More than any other, this section of the data handling system would profit the most from mark-sense or machine coding at the time of the examination.

The POOPS uses different parameters for submariners as contrasted with divers. At the time of examination, the limits for air-conduction and bone-conduction are set at the BUMED physical examination requirements which differ for these two classes.

LHS: AUDITORY

NAME:

LAST FIRST INITIAL

INDEX

0	3	1
1	2	3

TODAY'S DATE: DAY (4 5) MONTH (6 7) YEAR (8 9)

SOCIAL SECURITY NO.: (10 11 12) (13 14) (15 16 17 18)

BUMED INST. 6310.8A
FACILITY CODE PLACE: NSMRL

0	6	6	5	9	6
19	20	21	22	23	24

DATE OF BIRTH: DAY (25 26) MONTH (27 28) YEAR (29 30)

1. AIR CONDUCTION: LIST DB VALUES

A.C. RIGHT

	500	1000	1500	2000	3000	4000	6000	8000
CHECK IF NEGATIVE	31	34	37	40	43	46	49	52
NO RESPONSE (CIRCLE)	9 9	9 9	9 9	9 9	9 9	9 9	9 9	9 9
	32 33	35 36	38 39	41 42	44 45	47 48	50 51	53 54

A.C. LEFT

	500	1000	1500	2000	3000	4000	6000	8000
CHECK IF NEGATIVE	55	58	61	64	67	70	73	76
NO RESPONSE (CIRCLE)	9 9	9 9	9 9	9 9	9 9	9 9	9 9	9 9
	56 57	59 60	62 63	65 66	68 69	71 72	74 75	77 78

(CODER SKIP COLS. 79, 80. GO TO NEXT CARD)

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2. BONE CONDUCTION: LIST DB VALUES:

INDEX | 0 | 3 | 2 | : REPEAT COLUMNS 4 THROUGH 18.
1 2 3

B.C. RIGHT

	500	1000	1500	2000	3000	4000
CHECK IF NEGATIVE	19	22	25	28	31	34
NO RESPONSE (CIRCLE)	9 9	9 9	9 9	9 9	9 9	9 9
	20 21	23 24	26 27	29 30	32 33	35 36

B.C. LEFT

	500	1000	1500	2000	3000	4000
CHECK IF NEGATIVE	37	40	43	46	49	52
NO RESPONSE (CRICLE)	9 9	9 9	9 9	9 9	9 9	9 9
	38 39	41 42	44 45	47 48	50 51	53 54

3. PITCH MEMORY: LIST ITEMS MISSED [ ][ ]
55 56

4. HIGH FREQUENCY:

H.F. RIGHT

	4KC	6KC	8KC	9KC	10KC	11KC
CHECK IF NEGATIVE	57	60	63	66	69	72
NO RESPONSE (CIRCLE)	9 9	9 9	9 9	9 9	9 9	9 9
	58 59	61 62	64 65	67 68	70 71	73 74

	12KC	13KC
CHECK IF NEGATIVE	75	78
NO RESPONSE (CIRCLE)	9 9	9 9
	76 77	79 80

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AUDITORY (3)

INDEX: | 0 | 3 | 3 |

REPEAT COLUMNS 4 THROUGH 18:

	14KC	15 KC	16 KC	17 KC	18 KC	19 KC	20 KC
CHECK IF NEGATIVE							
	19	22	25	28	31	34	37
NO RESPONDE (CIRCLE)	9 9	9 9	9 9	9 9	9 9	9 9	9 9
	20 21	23 24	26 27	29 30	32 33	35 36	38 39

H.F. LEFT

	4 KC	6 KC	8KC	9 KC	10 KC	11 KC
CHECK IF NEGATIVE						
	40	43	46	49	52	55
NO RESPONSE (CIRCLE)	9 9	9 9	9 9	9 9	9 9	9 9
	41 42	44 45	47 48	50 51	53 54	56 57

	12 KC	13 KC	14 KC	15 KC	16 KC	17 KC	18 KC
CHECK IF NEGATIVE							
	58	61	64	67	70	73	76
NO RESPONSE (CIRCLE)	9 9	9 9	9 9	9 9	9 9	9 9	9 9
	59 60	62 63	65 66	68 69	71 72	74 75	77 78

(CODER: SKIP COLUMNS 79, 80) GO TO NEW CARD.

INDEX: 0 3 4 REPEAT COLUMNS 4 THROUGH 18.

	19 KC	20 KC
CHECK IF NEGATIVE		
	19	22
	9 9	9 9
	20 21	23 24

25

Mark 1 if Submariner
Mark 2 if Diver or Other

K.P.
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INDEX 051 - 070: PHYSICAL EXAMINATION

The intention of the LHS physical examination section is to equip the examining physician with an effective guide, easily followed and encouraging, to perform a complete and exacting examination. There also exists the important requirement for coding this physical profile for rapid, easy key punching and efficient analysis. A further requirement is that the examining physician be spared as much writing or coding as possible. Finally, the form must accommodate unusual or rare findings by use of explanations and narratives that the examining physician wishes to contribute to the existing physical profile. The physical examination follows widely accepted formats in its progression through the body systems. Only positive or abnormal findings are recorded and coded. Frequently noted "abnormalities" such as absent tonsils or circumcision are indicated for convenient marking. Tuberculin test reaction size (mm) is included, as is the number of tattoos. The following LHS Physical Findings form should be self-explanatory. POOPS limits are confined to absolute possibilities as indicated by the coding choices.

Blood pressures (INDEX 055) are recorded, along with heart rates, on a single index form. Three readings, the systolic (phase 1), significant change of muffling (phase 4), and diastolic readings (phase 5) are recorded. Heart rates are taken at the time of blood pressure reading. Right-arm readings are taken on two successive days in both the sitting and supine position for a total of four observations.

The two-observer method is used in taking blood pressures to enhance objectivity in this important data section. In the two observer system utilized at NSMRL one person uses the stethoscope and signals the second when the appropriate auscultatory events occur. The second observer manipulates the pressure release valve, observes the pressure gauge, and adjusts the equipment for the proper slow release of pressure (2-3 mmHg/beat). At the signal from the first observer he records the indicated pressure in even numbers.

Probably no physical examination form answers all the needs of every physician. However, after some months of use by a number of examiners, it is felt that this LHS form is quite effective in recording significant finding and yet highly efficient in terms of both examination and key punch time. A significant feature is the narrative section. It has proven to be very effective for inclusion of comments, descriptions or additions to the physical findings contained on the form.

LHS: PHYSICAL FINDINGS (1)

NAME:

LAST FIRST INITIAL

INDEX: 0 5 1 (1 2 3)

TODAY'S DATE: DAY (4 5) MONTH (6 7) YEAR (8 9)

SOCIAL SECURITY NO.: (10 11 12) (13 14) (15 16 17 18)

BUMED INST. 6310.8A
FACILITY CODE PLACE: NSMRL

DATE OF BIRTH: 0 6 6 5 9 6 (19 20 21 22 23 24) DAY (25 26) MONTH (27 28) YEAR (29 30)

NOTE TO EXAMINER: CIRCLE OR OTHERWISE MARK POSITIVES ONLY IN A PROMINENT FASHION. IF YOUR FINDING NEEDS AMPLIFICATION OR COMMENT, CHECK NEXT COMMENT BOX AND WRITE STATEMENT ON LAST PAGE.

BODY PART	POSITIVE/ABNORMAL	FIELD	PUNCH
NUTRITION	Obesity: Slight (1) Mod (2) Gross (3)	31	
HAIR	Balding at least:		
	10% (1) 50% (2) 100% (3)	32	
	Graying at least:		
	10% (1) 50% (2) 100% (3)	33	

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PHYSICAL (2)

BODY PART	POSITIVE/ABNORMAL	RIGHT	LEFT	BOTH	FIELD	PUNCH
EYES	Lids: Xanthalasma	(1)	(2)	(3)	34	
	Corneas: Arcus	(1)	(2)	(3)	35	
	Iris: Damage, scarring Pigmentation	(1)	(2)	(3)	36	
	Pupils: Unequal Size, Color			(3)	37	
	Reaction Abnormal	(1)	(2)	(3)	38	
	Other Abnormality	(1)	(2)	(3)	39	
	Retinas: Hemorrhages.	(1)	(2)	(3)	40	
	Exudates.	(1)	(2)	(3)	41	
	Retinal Vessel Spasm.	(1)	(2)	(3)	42	
	Nicking.	(1)	(2)	(3)	43	
	Pigment Abnormality.	(1)	(2)	(3)	44	
NOSE	Rhinophyma	(1)			45	
	Septal Deviation.	(1)			46	
MOUTH	Leukoplaka.	(1)			47	
	Ulcers (Incl. Herpangina, cold sores)	(1)			48	
THROAT	ABSENT TONSILS	(1)	(2)	(3)	51	
EARS	Pinnae: Absent	(1)	(2)	(3)	52	
	Tophi	(1)	(2)	(3)	53	
	Canals: Inflammation, Discharge.	(1)	(2)	(3)	54	
	Growth, Tumor.	(1)	(2)	(3)	55	
	TM'S: Scarring	(1)	(2)	(3)	56	
	Perforation	(1)	(2)	(3)	57	

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PHYSICAL (3)

BODY PART	POSITIVE/ABNORMAL	RIGHT	LEFT	BOTH	FIELD	PUNCH
EARS (Cont)	Mastoids: Scar, depressions.	(1)	(2)	(3)	58	
NECK	Thyroid: Mass/enlargement.	(1)	(2)	(3)	59	
	Enlarged Nodes: Posterior.	(1)	(2)	(3)	60	
	Anterior.	(1)	(2)	(3)	61	
	Carotid Pulsations: Absent or weaker.	(1)	(2)	(3)	62	
	Scars: Thyroidectomy	(1)	(2)	(3)	63	
	Biopsy, cervical.	(1)	(2)	(3)	64	
	Posterior cervical.	(1)			65	
SKULL	Operative Scars/Evidence of Trauma.	(1)			66	
*** COMMENTS ON ABOVE STATEMENTS: (1) AND ENTER LAST PAGE					80	

CODER: SKIP TO NEXT CARD

INDEX

0	5	2
1	2	3

CODER:
REPEAT COLUMNS 4-18

BODY PART	POSITIVE/ABNORMAL	RIGHT	LEFT	BOTH	FIELD	PUNCH
UPPER EXTREMITY :	Absence, all or part (long bones).	(1)	(2)	(3)	19	
	Nodes: Epitrochlear/ Axillary.	(1)	(2)	(3)	20	
	Hands: Tremor	(1)	(2)	(3)	21	
	Contractures Actual/ repaired.	(1)	(2)	(3)	22	
	Palmar erythema.	(1)	(2)	(3)	23	

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PHYSICAL (4)

BODY PART	POSITIVE/ABNORMAL	RIGHT	LEFT	BOTH	FIELD	PUNCH
UPPER EXTREMITY:	Fingers: Absence of any parts.	(1)	(2)	(3)	24	
	Surgical Repair, Scarring	(1)	(2)	(3)	25	
	Nicotine Stains.	(1)	(2)	(3)	26	
	Clubbing.	(1)	(2)	(3)	27	
	Bitten Nails.	(1)	(2)	(3)	28	
	Limited ROM Joint Disease	(1)	(2)	(3)	29	
*** COMMENTS ON 19 THROUGH 32. (1) AND ENTER LAST PAGE.					33	
		Mild	Mod	Severe		
THORAX	Shape: Pectus excavitum	(1)			34	
	Pigeon Breast.	(1)			35	
	Kyphosis.	(1)			36	
	Scoliosis.	(1)			37	
	Angiomas.	(1)	(2)	(3)	38	
	Accessory Nipples.	R (1)	L (2)	B (3)	39	
	Thoracotomy Scars.	(1)	(2)	(3)	40	
LUNGS	Sounds: Absent	(1)	(2)	(3)	41	
	Rhonchi, Rales	(1)	(2)	(3)	42	
	Prolonged Expiration.	(1)	(2)	(3)	43	
	Forced: Elicited Wheezing/ rhonchi	(1)	(2)	(3)	44	
	Impression of Emphysema:	Mild (1)	Mod (2)	Advanced (3)	45	
BACK	CVA Tenderness.	(1)	(2)	(3)	46	
	Scars: L/S Operative.	(1)	(2)	(3)	47	
	Nephrectomy.	(1)	(2)	(3)	48	

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BODY PART	POSITIVE/ABNORMAL		FIELD	PUNCH
BACK (Cont)	Less of curvature or flexion: L/S	(1)	49	
*** COMMENTS ON 34 THROUGH 54. (1) AND ENTER LAST PAGE.			55	
HEART	Observation: Abnormal	(1)	56	
	PMI: Significant Displacement; enlargement	(1)	57	
	Rhythm:			
	Extra systoles.	(1)	58	
	Irregularly Irregular.	(1)	59	
	Heart Sounds: Abnormal	(1)	60	
	Murmurs:			
	Systolic:(Grade 1 to 6)	ENTER NUMBER:	61	
	Diastolic: (Grade 1 to 6)	ENTER NUMBER:	62	
CLASSIFICATION IF APPLICABLE:				
	Functional: I (1) II (2) III (3) IV (4)		63	
	Therapeutic: A (1) B (2) C (3) D (4) E (5)		64	
*** COMMENTS ON 56 THROUGH 69. (1) AND ENTER LAST PAGE.			70	
ABDOMEN:				
	Scars: (ENTER NUMBER OF SCARS:)			
	RUQ		71	
	RLQ		72	
	LUQ		73	

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INDEX

0	5	4
1	2	3

CODER: REPEAT COLUMNS 4 - 18

BODY PART	POSITIVE/ABNORMAL	RIGHT	LEFT	BOTH	FIELD	PUNCH
NEUROLOGIC:						
CRANIAL NERVES:	I	(1)	(2)	(3)	19	
	II	(1)	(2)	(3)	20	
	III, IV, VI	(1)	(2)	(3)	21	
	V	(1)	(2)	(3)	22	
	VII	(1)	(2)	(3)	23	
	XIII	(1)	(2)	(3)	24	
	IX	(1)	(2)	(3)	25	
	X	(1)	(2)	(3)	26	
	XI	(1)	(2)	(3)	27	
	XII	(1)	(2)	(3)	28	
	Tics, Tremors	(1)			29	
	Cerebellar: Romberg	(1)			30	
	Augmented Romberg	(1)			31	
DTR's:	Biceps: Abnormal; Weaker	(1)	(2)	(3)	32	
	Quads: Abnormal; Weaker	(1)	(2)	(3)	33	
	Achilles: Abnormal; Weaker	(1)	(2)	(3)	34	
	Plantar: Abnormal; Weaker	(1)	(2)	(3)	35	
OTHER:	Sensation: Pain, Touch, Proprio.	(1)			36	
	Speech Abnormality, Stuttering	(1)			37	

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BODY PART	POSITIVE/ABNORMAL (ENTER NUMBER)	FIELD	PUNCH
ABDOMEN (Cont)	LLQ	74	
	Midline, Mostly upper.	75	
	Midline, Mostly lower..	76	
	R. Inguinal.	77	
	L. Inguinal.	78	
*** COMMENTS ON 71 THROUGH 79: (1) AND ENTER LAST PAGE.		80	

CODER: SKIP TO NEXT CARD.

INDEX

0	5	3
1	2	3

CODER: REPEAT COLUMNS 4 - 18

BODY PART	POSITIVE/ABNORMAL	RIGHT	LEFT	BOTH	FIELD	PUNCH
PALPATION:	Umbilical Hernia, opening.	(1)			19	
	Liver: Enlarged/Abnormal.	(1)			20	
	Spleen: Enlarged	(1)			21	
	Scar of Spleenectomy.	(1)			22	
	Kidney: Enlarged/mass/cystic	(1)	(2)	(3)	23	
	Inguinal: Lax Ring	(1)	(2)	(3)	24	
	Definite Hernia	(1)	(2)	(3)	25	

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BODY PART	POSITIVE/ABNORMAL	RIGHT	LEFT	BOTH	FIELD	PUNCH
	Other Abdom. Mass.	(1)	(2)	(3)	26	
	Femoral Pulses: Absent/ Diminished.	(1)	(2)	(3)	27	
GENITAL:	Scrotum: Varicocele.	(1)	(2)	(3)	28	
	Cystocele	(1)	(2)	(3)	29	
	Evidence of Vasectomy.	(1)	(2)	(3)	30	
	Testicles: Absence	(1)	(2)	(3)	31	
	Atrophy, Undescended	(1)	(2)	(3)	32	
	Abnormal: Including mass in scrotum.	(1)	(2)	(3)	33	
	PENIS: CIRCUMCISED:	(1)			34	
	Hypospadias	(1)			35	
RECTAL:	Pilonidal: Openings: Benign	(1)			36	
	Cysts.	(1)			37	
	Operative Scars.	(1)			38	
	Acute Hemorroids.	(1)			39	
	Hemorrhoid Tags	(1)			40	
	Fistulae	(1)			41	
	Polyp	(1)			42	
*** COMMENTS 19 TO 49: (1) AND ENTER LAST PAGE.					50	
	Prostate: Aynmmetrical Nodule	(1)			51	
	Other Mass.	(1)			52	
	Impression of Prostatitis.	(1)			53	

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PHYSICAL (10)

		FIELD	PUNCH
Definite Weakness	(1)	38	
Posture, Gait Abnormal	(1)	39	
Tremor	(1)	40	
Examine for Needle Tracks.	(1)	41	
Impression: Alcoholic Excess	(1)	42	
Psychiatric Referral Indicated	(1)	43	

*** COMMENTS: 19 TO 47: (1) AND ENTER LAST PAGE. 48

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BLOOD PRESSURES/RATES

INDEX

0	5	5
1	2	3

TODAY'S DATE: DAY (4 5) MONTH (6 7) YEAR (8 9)

SOCIAL SECURITY NO.: (10 11 12) (13 14) (15 16 17 18)

0	6	6	5	9	6
19	20	21	22	23	24

DATE OF BIRTH: DAY (25 26) MONTH (27 28) YEAR (29 30)

*(ALL RIGHT ARM) *

	Systolic	Change, Muffling	Final Diastolic
A. DAY 1			
SITTING, 2 MIN.	(31 32 33)	(34 35 36)	(37 38 39)
SUPINE, 2 MIN.	(40 41 42)	(43 44 45)	(46 47 48)
RATE			(49 50 51)
B. DAY 2			
SITTING, 2 MIN.	(52 53 54)	(55 56 57)	(58 59 60)
SUPINE, 2 MIN.	(61 62 63)	(64 65 66)	(67 68 69)
RATE			(70 71 72)

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COMMENTS ON PHYSICAL:

CODER: INDEX | 0 | 5 | 8 | TO | 0 | 7 | 0 | AS NEEDED: FIRST THREE COLUMNS EACH CARD.

REPEAT COLUMNS 4-18 ON EACH CARD.

EXAMINER: WRITE IN REMARKS; COMMENTS:

1. CONDENSE AS POSSIBLE.
2. NO NEED TO LIST BODY PART, STATEMENT NUMBER.

COMMENTS:

K.P.

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INDEX 071-072: VISION

Table XIV: Data Description for Index 071-072: Vision

INDEX 071

Data Sheet/ Card Columns	Data Description	Poops Limits
1 - 3	071 designates Index as vision.	071
4 - 30	Identification of person, place, time; as previously described (Table IV).	
31	Tonometry Method. This column indicates what method is used for pressure acquisition. At present the Schiotz method is being used. It is planned to use applanation in the future.	0 - 2
32 - 34	Intraocular Pressure in millimeters Hg. (OD:)	8 - 21
35 - 37	Intraocular Pressure in millimeters Hg. (OS:)	8 - 21
38 - 40	Accommodation in cm. A measure of the accommodating power of the individual is made by employing a Prentiss ruler. The subject focuses on a line of print, brings the print closer to him until it blurs. The test administrator records the distance.	7 - 15
41 - 42	Fundus vessel measurement: Artery (mm 10^{-2}).	22 - 30

Table XIV: Data Description for Index 071-072: Vision (Cont)

INDEX 071

Data Sheet/ Card Columns	Data Description	Poops Limits
43 - 44	Fundus vessel measurement: Vein (mm 10^{-2}). Retinal photographs are taken of the fovea and optic nerve area of the subject's right eye, after 1% Cyclogel is administered. The equipment used is the Zeiss Fundus Camera. Standard procedure is followed by an operator trained in retinal photography.[39] Measurements are made from these retinal photographs and recorded.	30 - 38
45	Refraction method: (1) Manifest OD and Manifest OS (2) Cycloplegic OD and Cycloplegic OS (3) Manifest OD and Prescription OD	0 - 3
46 - 69	A clinical refraction is performed with a cycloplegic. Equipment includes Snellen Eye Charts projected at a luminance level of 12 ft-L. by a projector, and a standard phoropter, Bausch and Lomb. For comparison of results, the method must be recorded. At present, refraction is performed on the right eye only, manifest and prescription, if applicable.[40,41]	
	Sphere	-5.00 - 5.00
	Cylinder	-5.00 - 5.00
	Axis	0 - 360

INDEX 072

Data Sheet/ Card Columns	Data Description	Poops Limits
1 - 3	072 designates Index as vision	072
4 - 18	Repeated from first card (071)	
19 - 37	Orthorater Score.[41] Visual acuity and phorias are measured by the Bauch and Lomb Ortho-Rater Test. Includes visual acuity, both monocular and binocular, at simulated 20 feet and 13 inches. Tests of phoria are performed for both the vertical and horizontal dimension at both near and far viewing conditions.	Item Limits F1 3 - 7 F2 6 - 11 F3 7 - 12 F4 7 - 12 F5 7 - 12 F6 1 - 9 N1 9 - 12 N2 9 - 12 N3 9 - 12 N4 3 - 6 N5 5 - 12
38 - 39	Pseudo-Isochromatic Plates: Most subjects are assumed to have been screened for adequate color vision. Nevertheless this extremely brief test is included for completeness.	0 - 4
40 - 44	Farnsworth 100-Hue Test	0 - 100
	Axes Mid-Point This is a quite sensitive and widely acceptable test of color vision with some normals scoring errors.[42] There is a rather extensive scoring procedure for the 100 Hue test by which the specific color errors are analyzed. This score is more informative and is listed as the mid-point of color axes.	01 - 85

Data Sheet/ Card Columns	Data Description	Poops Limits
45 - 52	Hecht-Schlaer Anomaloscope: A brief test (approximately 5 minutes), yields indication of relative sensitivities to red and green colors. This is widely used and accepted to determine type of defect.[42]	
	Red/Green Scores	45 - 50
	Brightness Scores	30 - 40

This LHS section, in its descriptive epidemiology function, has already been used in providing BUMED with information on visual acuity among submarine personnel. With the addition of the color vision section it is felt that this section is complete. An area of continuing interest at NSMRL has been the relationship of retinal measurement and blood pressure.[39] A pilot analysis of this information is planned in the near future. This analysis will be based upon information contained in Indexes 071 and 055, which contain retinal vessel measurements and blood pressures, respectively.

LHS: VISION (1)

NAME:

LAST FIRST INITIAL

INDEX: 0 7 1 (1 2 3)

TODAY'S DATE: DAY (4 5) MONTH (6 7) YEAR (8 9)

SOCIAL SECURITY NO.: (10 11 12) (13 14) (15 16 17 18)

BUMED INST. 6310.8A
FACILITY CODE PLACE: NSMRL

DATE OF BIRTH: 0 6 6 5 9 6 (19 20 21 22 23 24) DAY (25 26) MONTH (27 28) YEAR (29 30)

TONOMETRY:

SCHIOTZ: (1)
APPLANATION: (2)
(31) (ENTER NUMBER: 1 or 2 IF NO TEST: BLANK)

OD (32 33) . (34) mm.Hg.

OS (35 36) . (37) mm.Hg.

ACCOMODATION (PRENTISS RULER)
OD (38 39) . (40) cm.

FUNDUS VESSEL MEASUREMENT
ARTERY 0. (41 42) mm.

VEIN 0. (43 44) mm.

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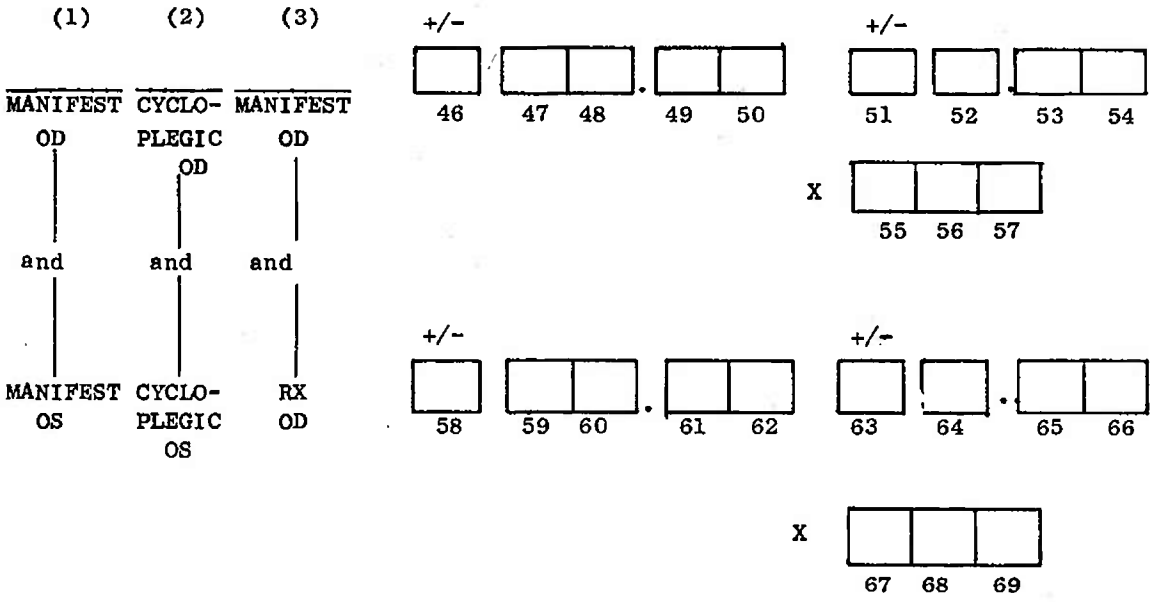
REFRACTION

METHOD: [ ] (45) (ENTER 1, 2, or 3 as indicated)

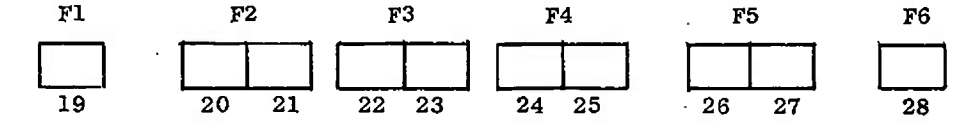


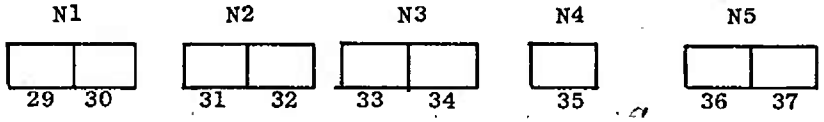
CODER: SKIP COLUMNS 70 TO 80, GO TO NEXT CARD

CODER:

INDEX: [0][7][2] : REPEAT COLUMNS 4 THROUGH 18.

ORTHORATER:





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COLOR VISION:

PLATES — FAILED: [ ][ ] 38 39

100 - HUE — ERRORS: [ ][ ][ ] 40 41 42

AXES MIDPOINT: [ ][ ] 43 44

ANOMALOSCOPE — RED/GREEN SCORES: [ ][ ][ ][ ] 45 46 47 48

BRIGHTNESS SCORES: [ ][ ][ ][ ] 49 50 51 52

[ ]
K.P.

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INDEX 081-082: CHEMISTRY/ HEMATOLOGY

The hematological and chemistry data are obtained by Colter Counter, Model S(CCMS) and Technicon SMA-12 (TSMA-12), respectively. Generally accepted parameters have been selected for this area of the LHS.

The LHS has a banked aliquot of each subject's serum, inventoried in this Index. Serum is labeled with the subject's name, social security number, and the date of serum acquisition. Index 081 contains the individual's serum inventory, with the milliliters of serum banked, recorded, and updated.

Since the serum is banked by date of collection, the amount available and physical location can be determined by simple data procedures.

Table XV: Data Description for Index 081-082: Chemistry

Data Sheet/ Card Columns	Data Description	Poops Limits
1 - 3	081 designates Index as chemistry.	081
4 - 30	Identification of person, place, time; as previously described (Table IV).	
31 - 32	Hematocrit, Colter Counter Model S.	41 - 49
33 - 35	Hemoglobin, Colter Counter Model S.	13 - 17
36 - 40	WBC, Colter S.	4.8 - 10.8K
41 - 53	White Cell Differential:	
	41-42 Neutrophils	40 - 75
	43-44 NonSeg., Bands	0 - 3
	45-46 Total lymphs	20 - 40
	47-48 Monocytes	0 - 9
	49-50 Eosinophils	0 - 5
	51-52 Basophils	0 - 3
	53 WBC abnormality	0

Table XV: Data Description for Index 081-082: Chemistry (Cont)

Data Sheet/ Card Columns	Data Description	Poops Limits
54 - 56	Glucose Test. Fasting	60 - 110
57 - 59	Glucose Test: 2 hour post prandial.	60 - 110
	Absolute difference between tests	0 - 30
60 - 62	Urine Specific Gravity using a gravity meter.	10 - 30
63 - 65	Albumin, Sugar and Occult Blood by Ames Labstix.	0
66 - 74	Microscopic urinalysis results as shown on Form.	
	RBC/WTSC	0 - 5
	Casts	0
75 - 76	Amount of serum available in serum bank (ml)	0 - 99

Under development is the measurement of Alpha-1 antitrypsin, based upon current information.[43,44]

INDEX 082

Data Sheet/ Card Columns	Data Description	Poops Limits
1 - 3	082 designates Index as chemistry (second card)	082
19 - 52	Technicon SMA-12 autoanalyzer parameter listed on following.	
	Ca^{++}	8.0 - 11.0
	Inorganic Phosphate	3.0 - 5.0
	Glucose	65 - 110
	BUN	10 - 20
	Uric Acid	2.5 - 8.0
	Cholesterol	150 - 280
	Tot. Protein	6.0 - 8.5
	Albumin	3.5 - 5.5
	Total Bilirubin	0.2 - 1.0
	Alk. Phosphatase	20 - 90
	LDH	100 - 225
	SGOT	10 - 50

LHS: CHEMISTRIES (1)

NAME

LAST FIRST INITIAL

INDEX: 0 8 1 (1 2 3)

TODAY'S DATE: DAY (4 5) MONTH (6 7) YEAR (8 9)

SOCIAL SECURITY NO.: (10 11 12) (13 14) (15 16 17 18)

BUMED INST. 6310.8A
FACILITY CODE PLACE: NSMRL

0 6 6 5 9 6 (19 20 21 22 23 24)

DATE OF BIRTH: DAY (25 26) MONTH (27 28) YEAR (29 30)

HEMATOCRIT (31 32)

HEMOGLOBIN (33 34) (35)

WBC: (36 37 38 39 40)

DIFFERENTIAL:

NEUT: (41 42)

NON-SEG, BANDS: (43 44)

TOTAL LYMPH: (45 46)

MONO: (47 48)

EOS: (49 50)

BASO: (51 52)

WBC MORPH, ABNORMALLY:
(EG: ATYPICAL LYMPHOCYTES):

IF YES, ENTER THE NUMBER
1 IN BOX: (53)

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GLUCOSE TESTS:

FASTING: [ ][ ][ ] 54 55 56

2 HR P.P.: [ ][ ][ ] 57 58 59

URINE:

S. G. 1. [ ][ ][ ] 60 TO 62

ALBUMIN (0 TO 4) [ ] 63

SUGAR (0 TO 4) [ ] 64

OCC BLD (0 TO 3) [ ] 65

MICRO RBC/HPF - HIGHEST [ ][ ] 66, 67

WBC/HPF - HIGHEST [ ][ ] 68, 69

CASTS, RBC (YES = 1) [ ] 70

WBC (YES = 1) [ ] 71

HYALIN (YES = 1) [ ] 72

CRYSTALS (YES = 1) [ ] 73

AMORPHOUS (YES = 1) [ ] 74

Amount of Serum Banked [ ][ ] ml.

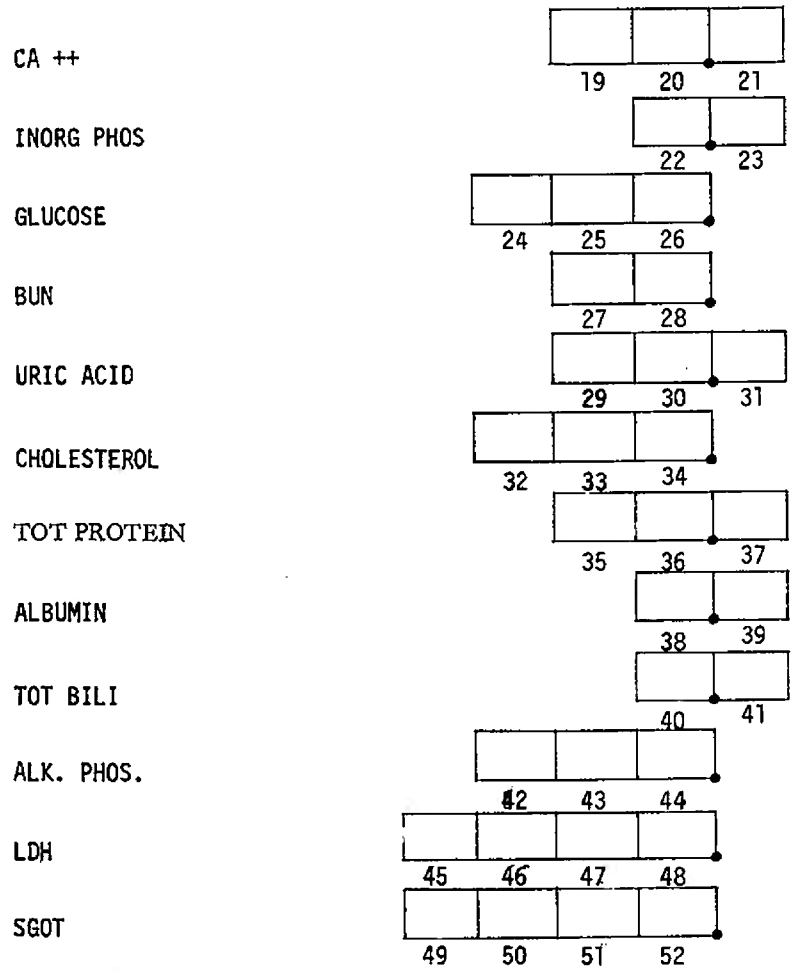
75 76

LHS: CHEMISTRIES (3)

INDEX

0	8	2
1	2	3

CODER: USE 1 PUNCH FOR ALL CHECKS



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INDEX 091-100: MEDICAL HISTORY

Seven Index cards are devoted to coding of medical history. In addition to the usual medical history, this section includes questions concerning trauma and other conditions associated with diving. Table XVII lists these history sections with some descriptive comments. The forms themselves follow this descriptive section and are essentially self-explanatory.

Table XVII: Longitudinal Health Study Medical History Section

Index	History	Comments	Poops Limits
091	Allergy	Includes a listing of common allergens including medicines. More extensive history may be entered in physical examination narrative. Positives are indicated by a 1-punch as shown.	0 - 1
092	Habits	Provides information concerning basic habits, defining both the extent and duration. Habits described include:	
		Cigarettes packs/day	0 - 3.0
		Cigars/Pipes per day	0 - 20
		Coffee cups/day	0 - 9
		Beer/shots/wine glasses/week	0 - 50
		Use is described in amount appropriate to the given habit at 5-year intervals (e.g., pack/year of cigarette smoking can be estimated.)	
093	Operations	Description of major surgery, entered by age at occurrence and ICDA-8 coding of surgical procedures.	
		Age	0 - 60
		If age greater than 1: ICDA-8	Greater than 1

Table XVII: Longitudinal Health Study Medical History Section (Cont)

Index	History	Comments	Poops Limits
094	Illnesses	Entered age at beginning of symptoms, along with ICDA-8 coding. An illness may be recorded any number of times.	
		Age	0 - 60
		If age greater than 1: ICDA-8	Greater than 1
096	Family History	Common and significant familial illnesses are listed with a 2-digit code which (with expansion to 99 illnesses) and now includes 14 illnesses as shown. Familial disease is indicated simply by picking the appropriate person and illness from the two lists. The coding system developed has proven itself to be convenient and effective. It allows highly rapid and multiple scanning, and has extensive expansion capabilities. Relative and diseases may be entered any number of times.	
098	Trauma	Confined to relatively serious trauma.	
099	Special Trauma	Listings are of significance in the diving population. Contains decompression sickness, air embolism, other barotrauma. Coding includes age of occurrence, treatment used, and ICDA-8 coding. Episodes of skin bends are not recorded.	
		Age	0 - 60
		If age greater than 0:	Greater than 0
		If age greater than 1:	Greater than 1
		Treatment Table Number	1 - 6

Table XVII: Longitudinal Health Study Medical History Section (Cont)

Index	History	Comments	Poops Limits
100	Diving History	A prototype diving history form is being studied to evaluate the effect of diving and hyperbaric environment on an individual. Some quantitation of this exposure must be made. Included are number of months in escape tank work, estimated total number of dives by types, depth of 5 deepest dives, number of hours of saturation exposure, and total number of years in both civilian and military diving.	

This section of seven index cards covers the broad areas of medical history. It is effective in the rapid accumulation of medical information. An event or illness is recorded by the age which the incident occurred or began and ICDA-8 coding for the illness or operation. Further, any unusual or significant item of history in any of the sections may be included in the narrative summary of the physical examination. In the Habits section, construction of a dose-time curve is possible since habit level is not recorded as present level only, but as a true use curve over the person's lifetime. Another area that has proven most satisfactory is Family History, which provides a rapid coding system and which accommodates a very flexible fashion and a complete family disease history, including any number of relative and disease combinations.

The Trauma section has been restricted to major trauma only. The special trauma section in the case of decompression sickness, has been restricted to that of diagnosed bends, with skin bends omitted.

NAME:

LHS: HISTORY (1)

LAST FIRST INITIAL

INDEX: 0 9 1 (1 2 3)

TODAY'S DATE: DAY (4 5) MONTH (6 7) YEAR (8 9)

SOCIAL SECURITY NO.: (10 11 12 13 14 15 16 17 18)

BUMED INST. 6310.8A

FACILITY CODE PLACE: NSMRL 0 6 6 5 9 6 (19 20 21 22 23 24)

DATE OF BIRTH: DAY (25 26) MONTH (27 28) YEAR (29 30)

CODER: USE 1 PUNCH FOR ALL CHECKS

HISTORY: ALLERGY: (1) FOR ALL POSITIVES

GENERAL:	HAY FEVER POLLEN, RAGWEED	52	SEVERE TO PLANTS (IVY, SUMAC)	53
	ANIMAL DANDER	54	OTHERS:	55
	STINGING INSECTS	56		57
MEDICINE:	PENICILLIN	58	PHENOTHIAZIDES	59
	SULFA	60	PROCAINE/LIDOCAINE	61
	TETRACYCLINE	62	HALOTHANE	63
	HEXACHLORAPHINE	64	X-RAY DYE	65
	CODIENE	66	OTHERS	67
	ASPIRIN	68		69
FOODS:	SEAFOOD	70	OTHERS	71
	FRUITS	72		73
	CHINESE FOOD	74		75
MATERIALS:	WOOL	76	RUBBER	77
	JET FUEL	78	OTHER	79
	OTHER	80		K.P. 6/72

INDEX

0	9	2
1	2	3

LHS: HISTORY (2)
HABITS

CODER: REPEAT COLUMNS 4 THROUGH 18

AGE (YEARS)	CIGARETTES PACKS/DAY	CIGARS/PIPES PER DAY	COFFEE CUPS/DAY*	BEER/SHOTS/WINE PER WEEK
15	[ ][ ] (19 20)	[ ][ ] (35 36)	[ ] (51)	[ ][ ] (59 60)
20	[ ][ ] (21 22)	[ ][ ] (37 38)	[ ] (52)	[ ][ ] (61 62)
25	[ ][ ] (23 24)	[ ][ ] (39 40)	[ ] (53)	[ ][ ] (63 64)
30	[ ][ ] (25 26)	[ ][ ] (41 42)	[ ] (54)	[ ][ ] (65 66)
35	[ ][ ] (27 28)	[ ][ ] (43 44)	[ ] (55)	[ ][ ] (67 68)
40	[ ][ ] (29 30)	[ ][ ] (45 46)	[ ] (56)	[ ][ ] (69 70)
45	[ ][ ] (31 32)	[ ][ ] (47 48)	[ ] (57)	[ ][ ] (71 72)
50	[ ][ ] (33 34)	[ ][ ] (49 50)	[ ] (58)	[ ][ ] (73 74)

*IF OVER 9, ENTER 9.

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INDEX

0	9	3
1	2	3

LHS: HISTORY (3)
OPERATIONS, SURGERY

CODER: REPEAT COLUMNS 4 THROUGH 18

LIST ALL SURGICAL PROCEDURES

TYPE OF OPERATION:	AT YOUR AGE:	DO NOT FILL IN.
EXAMPLE: TONSILS (T&A)	0 7	2 1 2
1. _____	19 20	21 22 23
2. _____	24 25	26 27 28
3. _____	29 30	31 32 33
4. _____	34 35	36 37 38
5. _____	39 40	41 42 43
6. _____	44 45	46 47 48
7. _____	49 50	51 52 53
8. _____	54 55	56 57 58
9. _____	59 60	61 62 63
10. _____	64 65	66 67 68
11. _____	69 70	71 72 73
12. _____	74 75	76 77 78

NOTE: a. Appendectomy: 41.1
b. Repair Hernia:
Inguinal: 38.2
Recurrent: 38.3
c. Circumcision: 61.2
d. Vasectomy: 60.1

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INDEX

0	9	4
1	2	3

LHS: HISTORY (4)
ILLNESSES

CODER: REPEAT COLUMNS 4 THROUGH 18

LIST ALL MEDICAL ILLNESSES

	TYPE OF ILLNESS:	DISCOVERED, BEGINNING AT AGE: *	DO NOT FILL IN.
EXAMPLE:	HEPATITIS	2 1	0 7 0 0
1.	_____	19 20	21 22 23 24
2.	_____	25 26	27 28 29 30
3.	_____	31 32	33 34 35 36
4.	_____	37 38	39 40 41 42
5.	_____	43 44	45 46 47 48
6.	_____	49 50	51 52 53 54
7.	_____	55 56	57 58 59 60
8.	_____	61 62	63 64 65 66
9.	_____	67 68	69 70 71 72
10.	_____	73 74	75 76 77 78

* UNDETERMINED, UNKNOWN: 99

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0	9	6
1	2	3

CODER: REPEAT COLUMNS 4 THROUGH 18.

EXAMPLE: MATERNAL GRANDMOTHER HAD DIABETES.

0	8

0	6

FAMILY: RELATIVES: CODE

FATHER	1	MOTHER	2
BROTHERS	3	SISTERS	4
FATHER'S		MOTHER'S	
FATHER	5	FATHER	7
MOTHER	6	MOTHER	8
FATHER'S		MOTHER'S	
BROTHER	9	BROTHER	11
SISTER	10	SISTER	12

DISEASES, CAUSE OF DEATH: CODE:

1. Cardiovascular Disease/Angina/Heart Attacks
2. Stroke Brain Hemorrhage
3. Cancer
4. Lung Disease, Emphysema
5. Hypertension
6. Diabetes Mellitus
7. Mental Illness/Suicide/Hospitalization
8. Tuberculosis
9. Allergies, Asthma
10. Migraine Headaches
11. Bleeding Tendency
12. Porphyria
13. Sickle Cell Disease/ Tendency
14. Emphysema, chronic lung disease
15.
16.
17.
18.
19.
20.

RELATIVE	DISEASE
19 20	21 22
23 24	25 26
27 28	29 30
31 32	33 34
35 36	37 38
39 40	41 42
43 44	45 46
47 48	49 50
51 52	53 54
55 56	57 58
59 60	61 62
63 64	65 66
67 68	69 70
71 72	73 74
75 76	77 78

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INDEX

0	9	8
1	2	3

LHS: HISTORY (6)
TRAUMA
ACCIDENTAL INJURY

CODER: REPEAT COLUMNS 4 THROUGH 18

LIST ALL TRAUMA, ACCIDENTAL INJURY

TYPE OF TRAUMA, ACCIDENTAL INJURY	AT YOUR AGE	DO NOT FILL IN.
EXAMPLE: FRACTURE, LOWER TIBIA	2 0 (19 20)	8 2 4 0 (21 22 23 24)
1. _____	(19 20)	(21 22 23 24)
2. _____	(25 26)	(27 28 29 30)
3. _____	(31 32)	(33 34 35 36)
4. _____	(37 38)	(39 40 41 42)
5. _____	(43 44)	(45 46 47 48)
6. _____	(49 50)	(51 52 53 54)
7. _____	(55 56)	(57 58 59 60)
8. _____	(61 62)	(63 64 65 66)
9. _____	(67 68)	(69 70 71 72)
10. _____	(73 74)	(75 76 77 78) [ ]

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LHS: HISTORY
SPECIAL TRAUMA: BENDS, DECOMPRESSION SICKNESS, EMBOLISM, BAROTRAUMA

NAME:

LAST FIRST INITIAL

INDEX [0][9][9] (1 2 3)

TODAY'S DATE: DAY [ ][ ] (4 5) MONTH [ ][ ] (6 7) YEAR [ ][ ] (8 9)

SOCIAL SECURITY NO.: [ ][ ][ ] (10 11 12) [ ][ ] (13 14) [ ][ ][ ][ ] (15 16 17 18)

LIST ALL SPECIAL TRAUMA:

	TYPE OF TRAUMA	AT YOUR AGE	IF TREATED LIST TABLE NO. A: 1 PUNCH	DO NOT FILL IN.
EXAMPLE:	BENDS	[2][0]	[5][A]	[9][9][3][3]
1.	_____	[ ][ ] (19 20)	[ ][ ] (21 22)	[ ][ ][ ][ ] (23 24 25 26)
2.	_____	[ ][ ] (27 28)	[ ][ ] (29 30)	[ ][ ][ ][ ] (31 32 33 34)
3.	_____	[ ][ ] (35 36)	[ ][ ] (37 38)	[ ][ ][ ][ ] (39 40 41 42)
4.	_____	[ ][ ] (43 44)	[ ][ ] (45 46)	[ ][ ][ ][ ] (47 48 49 50)
5.	_____	[ ][ ] (51 52)	[ ][ ] (53 54)	[ ][ ][ ][ ] (55 56 57 58)
6.	_____	[ ][ ] (59 60)	[ ][ ] (61 62)	[ ][ ][ ][ ] (63 64 65 66)
7.	_____	[ ][ ] (67 68)	[ ][ ] (69 70)	[ ][ ][ ][ ] (71 72 73 74)

DATE OF BIRTH: DAY [ ][ ] (75 76) MONTH [ ][ ] (77 78) YEAR [ ][ ] (79 80)

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LHS: DIVING HISTORY

LIST OF QUESTIONS FOR DIVING QUESTIONNAIRE:

1. NAME:

2. SOCIAL SECURITY NUMBER:

3. BIRTH DATE: DAY: MONTH: YEAR:

4. PRESENT RATE: E- O-

5. LIST OF DIVING TRAINING, MILITARY AND CIVILIAN:

6. CERTIFICATION OF DIVING RATES:

7. NUMBER OF MONTHS IN ACTIVE ESCAPE TANK WORK:

8. ESTIMATED TOTAL NUMBER OF DIVES:

   SCUBA:_____ DEEP AIR:_____ SHALLOW WATER:_____

   HEO_2: _____ BREATHHOLDING:_____

9. DEPTH OF FIVE DEEPEST DIVES: _____ _____

   _____ _____ _____

10. NUMBER OF HOURS OF SATURATION EXPOSURE INCLUDING DECOMPRESSION:

11. TOTAL NUMBER OF YEARS IN DIVING CAREER: MILITARY: _____

12. TOTAL NUMBER OF YEARS IN DIVING CAREER: CIVILIAN: _____

13. LIST: HITS _____ BODY LOCATION _____ TREATMENT _____ TABLE _____

ECG: NO INDEX ASSIGNMENT AT PRESENT

A standard 12-lead electrocardiogram is performed on each LHS subject. At the present time this ECG is mounted, read, filed and stored for future reference. Any ECG abnormalities are listed in the physical examination narrative section.

In keeping with the purposes of this multiphasic study of a large population, the present ECG processing method should be considered unsatisfactory. We wish to accumulate data on ECG parameters for descriptive epidemiology purposes. Also, we wish to retain the ECG information on a given individual for later comparison. Third, we wish to screen this large population for ECG abnormalities of pathological significance and achieve a rapid feedback on this screening. These goals of volume storage, retrieval, analysis and screeming indicate the need for computer processing of ECG information. The factors of reproducibility and accuracy virtually preclude the use of individual human ECG analysis.[46]

Effort has been devoted in the search for the best answer for this requirement.[47,48] The most effective and reliable method appears to be the contracting for an ECG analysis service. The analog to digital conversion should be accomplished at the subject with storage of the digital information on tape. This taped information could be then mailed or transmitted for analysis and parameter printout suitable for storage and epidemiologic investigations. An example is included in in Appendix C. More elaborate, rapid, and costly methods are really unnecessary. Involvement in analysis programs should be avoided.

TIME OF PROCESSING:

Table XVIII lists the time needed for the processing of a single individual through the phases of the LHS. It must be realized that these are approximations and may vary greatly with the scheduling experience and ability of the investigators, and upon the availability of the necessary specialist services. Two hours should be added to the test time estimation to account for waiting and movement time. With precise scheduling, three or fewer subjects can be completely processed in a single long day of testing. The times shown as totals are rough since the duration of a phase will vary greatly with each subject, and those amenable to group testing will show increasing efficiency with greater group size.

Table XVIII. Approximations of Time Required For LHS Process of Single Subject

Index	Personnel	Test Time	Processing, Interpretation, Coding	Translation, Key Punch
001	HM	10* Min.	5 Min.	6 Min.
011	HM	120*	10	5
015	HM	20		8
020	HM;Chest	5	5	4
	HM, Medical Officer (Radiologist)	30	30	
021	Dental Officer	45		4
025	HM	30		5
031	HM	45*	20	18
051	M.O. & HM	30	5	5
071	HM	60	30	10
081	HM	15	45	8
091	HM	10		15
ECG	HM	10	15	
TOTALS:				
	DO	45 Min.	165 Min.	88 Min.
	MO	30		
	HM	420	115	

*Group processing possible.

GENERAL DISCUSSION:

At its point of conception the goal of the LHS was the definition of biologic changes in the subject population over many years time. The first groups processed were selected from the enlisted Submarine School students who stated a definite career intention in the U.S. Navy. This approach was considered inappropriate in that it ignored random selection requirements of such a study, and was rather naive in its acceptance of the predictability of enlisted submarine school students. Further, such a restrictive scope would delay the achievement of meaningful results for some years time.

Currently, the LHS is a functional system for the collection of data of descriptive epidemiology of randomly selected samples of the entire submarine and diving population. It has immediate value as a representation of the existing population, describing the biologic characteristics of the population. It has all the requirements of a prospective cohort study since many of the subjects will remain in the Naval service. It has the necessary factors for a retrospective survey since extensive medical history and occupational exposure information is collected. In addition, as long as a random selection of personnel is continued, the data may legitimately be compared to that of other special study groups or any similarly selected and tested group from the U.S. Navy. Finally, study individuals who remain accessible may be compared to themselves in time.

The development of this examination system has not been without difficulty in the climate of variations in personnel, interest, and with repeated interruptions due to the demands of other projects of greater priority. However, the concept and development of this study has been consistently directed toward a true multiphasic medical examination system based upon sound epidemiologic criteria. This concept connotes an examination and data handling system that is efficient both in terms of the examined subjects and the examining personnel, intimately linked with a reliable and efficient data system for storage, retrieval and analysis. The technique used was that of repeatedly reshaping and restructuring of the examination and data system through repeated passages of small groups of subjects. Thus, the objective was not the processing of legions of individuals during the developmental stage, but the most rapid construction of a quality system which would ultimately be quite capable of absorbing large numbers of subjects and the processing of large masses of data.

The LHS at present is:

1. Functional in all phases;

2. Reliable as demonstrated in repeated runs;

3. Capable of processing large test populations;

4. Flexible and expandable;

5. Protected to a high degree against the storage and analysis of erroneous data;

6. Compatible with any computer language system;

7. Economical in terms of subjects and research personnel time.

The use of medical technicians and automatic data handling has been maximized, and physician time and written recording minimized.

It must be realized, however, that the factors impeding such a research effort are many, and can be listed as follows:

1. Variations in the political and funding climate;

2. The population studied is relatively large and scattered in a number of locations around the free world;

3. Effects seen will not be completely dependent upon occupational exposure since the population is also exposed to the mundane causes of morbidity and mortality;

4. The number of individuals available for repeated examinations over 5 or 10 year intervals will dwindle due to the large attrition of personnel from the submarine and diving forces and the Navy itself.

STAFF REQUIREMENTS:

It must be emphatically stated that effective performance in such a multiphasic tightly scheduled physical examination system is dependent upon a knowledgable and efficient staff. Further, continuity in direction, knowledge, techniques, and attitude is an absolute necessity. From the operating experience with the LHS in processing a large number of individuals, significant difficulties were encountered due to rotation of personnel through normal tour of duty changes and other NSMRL projects, and loss of personnel to other duties. These changes became a constant hazard to the function of the LHS and involved all military personnel. Therefore, it seems quite reasonable that the repository of continuity must be in those individuals who are immune to these changes. This indicates that the leadership and "core" of the team must rest upon civilian and specially designated "safe" military personnel. The LHS system has been designed with flexibility to absorb significant change. However, this does not include great shifts in the operating research personnel. It is felt that the director of the entire project and key personnel in each examination area should be of a permanent nature. This will not only insure and enhance continuity but will preclude significant disruption due to changes in military billet levels and assignment delays.

DATA SYSTEM:

The development of the LHS data system is considered to be a significant accomplishment in the project. The concepts of data acquisition, translation, editing, and analysis has created a functional and effective system. As previously described, the primary objectives at this stage of development has been the completion of a data system up to the point of storage or edited and corrected data. The basic design of the LHS data

system has provided flexibility in accommodating any changes in data format or arrangement. The printout and editing functions have been successfully achieved with the development of the POOPS system. NSMRL reorganization removed program development from the LHS staff, transferring this to the NSMRL Data Processing Group. At the present time, these POOPS programs have been completed and are operational for nine of the twelve phases. Completion of these editing and printout programs for the entire study is imminent. This will permit editing of all possible variables in each of the twelve examination phases and the production of legible printouts.

The POOPS programs, once completed, will provide the LHS with a high degree of certainty in the area of data reliability. The LHS cannot be considered functional until this section has been satisfactorily completed. Further, with the large number of variables collected on each subject and the anticipated subject load, machine scanning of data points for pathological significance must be considered a necessity for ethical reasons.

The next task contemplated for development by the Data Processing Section is a special program combining the features of the POOPS system with a compressed printout format. This program system is designed to accept the entire LHS data information of an individual subject and produce a single summary page, amenable to health record inclusion, listing routine medical examination information, and indicating abnormal findings.

RECOMMENDATIONS:

1. Complete POOPS programs;

2. Begin examination of Fleet Ballistic Missile Submarine off-crews; random selection of subjects;

3. Begin analysis of LHS data;

4. Following POOPS, require data processing section to reproduce all cards for twin secure storage;

5. Request surface Navy control group inclusion;

6. Set up computer processing of ECG's;

7. Design an organization system to incorporate pertinent civilian personnel in key positions for submission to appropriate authorities;

8. Design a printout program to process information on individual subjects for condensation on a summary sheet for rapid perusal, reporting, and inclusion in health record.

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APPENDIX A

O.C.

LHS PULMONARY FUNCTION 025

INDEX	DATE (DMY)	SOC-SEC-NO	PLACE	DOB	AGE	KILO	HEIGHT	FVC	FEV1/ R1	FEV2/ R2	MEFR/ TLC	MVV/ R3	ERV	RV	FRC	RAW
025	22 02 72	001222005	066596	08 03 34	37	88	71	4.76	3.77 .79	4.23 .89	10.98 6.28	143 .24	1.50	1.52	3.02	3.07
025	18 07 72	001428373	066596	04 12 52	20	79	73	6.26	5.04 .81	6.07 .97	9.87 8.46	176 .26	1.98	2.20	4.18	2.05
025	06 06 72	004486283	066596	05 12 46	25	64	68	5.00	4.02 .80	4.74 .95	7.41 8.06	151 * .38	1.87	3.06	4.93	1.33
025	03 12 71	012361607	066596	14 08 46	25	66	65	4.92	4.27 .87	4.71 .96	10.46 6.01	171 .18	1.35	1.09	2.44	2.35
025	20 07 71	020288888	066596	08 01 37	34	80	67	4.70	3.82 .81	4.27 .91	8.78 6.12	145 .23	1.78	1.42	3.20	2.21
025	30 05 72	023263962	066596	08 03 35	37	87	72	6.12	3.83 * .63	5.03 * .82	5.28 8.78	130 * .30	1.55	2.66	4.21	2.14
025	02 12 70	025420729	066596	10 06 53	17	60	70	4.83	4.49 .93	4.73 .98	7.53 6.53	121 .26	1.47	1.70	3.17	1.83
025	13 06 72	028284858	066596	24 12 37	34	71	70	6.05	5.23 .86	5.76 .95	10.90 8.86	198 * .32	1.70	2.81	4.51	1.73
025	04 08 71	041423580	066596	18 02 47	24	72	72	6.10	5.08 .83	5.93 .97	9.35 8.49	159 .28	2.54	2.39	4.93	1.90
025	15 07 71	042288524	066596	15 06 36	35	62	65	4.61	3.62 .79	4.17 .90	10.78 6.18	129 .25	.80	1.57	2.37	2.52
025	07 03 72	042326461	066596	31 08 43	28	79	71	6.69	5.79 .87	6.48 .97	11.63 9.33	231 .28	2.34	2.64	4.98	1.41
025	06 08 71	043465445	066596	04 05 51	20	73	72	5.38	4.31 .80	5.08 .94	8.90 7.30	172 .26	2.29	1.92	4.21	2.68
025	10 11 70	044461673	066596	16 03 53	17	84	73	5.89	4.25	5.35	7.81	109	1.60	1.47	3.07	2.70

APPENDIX B

NAVAL SUBMARINE MEDICAL RESEARCH LABORATORY
NAVAL SUBMARINE MEDICAL CENTER
NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT 06340

AUGUST 1972

PROTOCOL FOR RADIOGRAPHIC EXAMINATION FOR ASEPTIC BONE NECROSIS*

The following body areas are radiographed to determine the presence of aseptic bone necrosis: both shoulders, both hips and both knees. Other areas may be examined if clinically suspected to be involved, but these other areas are optional and are not usually included in our radiographic survey.

Each of the above areas is radiographed individually to obtain the maximum of radiographic detail, i.e., each hip is radiographed separately; both hips are never included on the same film. The smallest focal spot available is employed to increase the radiographic detail. Adequate penetration (Kv) of the appropriate bone must be used but a high Mas technique is employed to obtain the greatest contrast of the bone structures. The following table is recommended as an example technique but may be modified according to the radiographic equipment available. All the films are radiographed with a moving Bucky grid on 10 x 12 inch cassettes containing par speed screens.

The following films are included in a radiographic survey:

1. Shoulders: Anteroposterior films with the shoulder in internal and external rotation. (2 films) The Grashey position is used because it affords an excellent view of the articulating surfaces of the glenoid of the scapula and the head of the humerus. Center 1" below the coracoid process of scapula and cone to show as much humerus as possible bringing in the lateral diaphragm to show only the head and shaft of the humerus.

Suggested Technical Factors: 40 MAS; 2 X (thickness of part in centimeters) plus 50 kv.

2. Knees: Anteroposterior and lateral. Center at the level of the upper border of the patella. The field should include the distal femur from a point proximal to the mid point and the proximal tibia and fibula to the mid point or just beyond. (2 films)

Suggested Technical Factors: 30 MAS; 2 X (thickness of part in centimeters) plus 50 kv.

3. Hips: Anteroposterior and frog-position lateral. (2 films) Maximum femur shaft should be obtained while assuring inclusion of the entire joint surface. For A.P. projection, center over the head of the femur, i.e., 1" below the mid point of a line joining the anterior superior iliac spine and the upper border of the pubic symphysis. The feet should be 90 degrees to the table top. GONAD PROTECTION MUST BE USED.

Suggested Technical Factors: 60 MAS; 2 X (thickness of part in centimeters) plus 50 Kv.

**In collaboration with James R. NELLEN, MD.*

APPENDIX C

MEDICAL SYSTEMS DEVELOPMENT LABORATORY - HEART DISEASE CONTROL PROGRAM
COMPUTER PROCESSED ELECTROCARDIOGRAM

13

PAT 81761 TAPE 627 DATE 08-28-69 OPTION 000
39 YRS MALE 6 FT 2 IN 208 LBS. MEDS NONE BP NORMAL

	I	II	III	AVR	AVL	AVF	V1	V2	V3	V4	V5	V6	Z7
PA	.04	.12	.07	-.05	-.03	.08	.05	.00	.00	.04	.05	.04	PA
PD	.04	.12	.10	.06	.06	.10	.06	.00	.00	.05	.06	.06	PD
Q/SA	-.04	.00	.00	-.65	.00	.00	.00	.00	.00	.00	-.07	-.08	Q/SA
Q/SD	.02	.00	.00	.04	.00	.00	.00	.00	.00	.00	.02	.02	Q/SD
RA	.59	.85	.32	.23	.22	.52	.22	.67	.81	1.77	2.07	1.45	RA
RD	.04	.05	.05	.05	.05	.05	.04	.05	.06	.06	.04	.05	RD
SA	-.07	-.39	-.34	.00	.00	-.34	-.63	-1.22	-1.07	-.73	-.31	-.18	SA
SD	.03	.06	.06	.00	.00	.05	.08	.06	.06	.05	.05	.04	SD
RPA	.00	.00	.00	.00	.04	.00	.00	.00	.00	.00	.00	.00	RPA
RPD	.00	.00	.00	.00	.04	.00	.00	.00	.00	.00	.00	.00	RPD
ST	.11	.12	.12	.06	.12	.12	.07	.12	.12	.12	.12	.05	ST
STO	.03	.05	-.02	.05	.06	.04	.03	.07	.10	.05	.06	.04	STO
STM	.06	.13	.03	.01	.04	.11	.05	.24	.25	.19	.17	.06	STM
STE	.09	.26	.06	-.02	.04	.17	.06	.48	.54	.46	.42	.08	STE
TA	.29	.46	.16	-.32	.07	.30	.13	.76	.83	.86	.77	.51	TA
TD	.16			.20			.18					.22	TD
PR	.11	.17	.17	.14	.16	.17	.17	.00	.00	.13	.12	.12	PR
QRS	.09	.11	.11	.09	.09	.10	.12	.11	.12	.11	.11	.11	QRS
QT	.37	.37	.36	.36	.28	.37	.37	.40	.41	.39	.38	.39	QT
RATE	60	70	57	61	68	63	68	61	60	60	72	65	RATE
CODE	3	2C	2	3	3L	2	2	2C	2C	2C	3	3	
CAL	97	97	97	97	97	97	97	97	97	97	97	97	CAL

AXIS IN	P	QRS	T	Q	R	S	STO	ST-T	QRS-T
DEGREES	65	27	56		48	263	23	33	29

1131 RATE UNDER 60 1 LEAD

NORMAL ECG

MSDL DEVELOPMENTAL VERSION
C 7A-27-16-09

---------- M.D.

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13. ABSTRACT

A multiphasic medical screening program has been developed for randomly selected submarine and diving personnel. Each individual passes through each of twelve phases of data collection: a statement of personal background and history, psychological testing, selected anthropometry, x-ray, dental evaluation, pulmonary function tests, audiometry, electrocardiogram, vision tests, selected blood chemistry analysis, blood pressure determination and physical exam. The accumulated data is being coded on Holerith cards for each of storage, retrieval and ultimate computer analysis. The present report defines the scope and objective of each of the measured parameters as well as the computer programs developed for the processing of these parameters.

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